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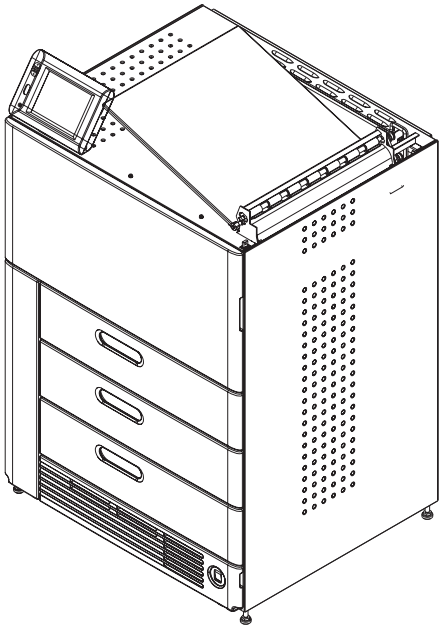
Information

THEORY GUIDE
for the
Kodak DryView 6800 LASER IMAGER
Service Code: 1649

Important

Qualified service personnel must repair this equipment.



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This equipment includes parts and assemblies sensitive to damage from electrostatic discharge. Use caution to prevent damage during all service procedures.

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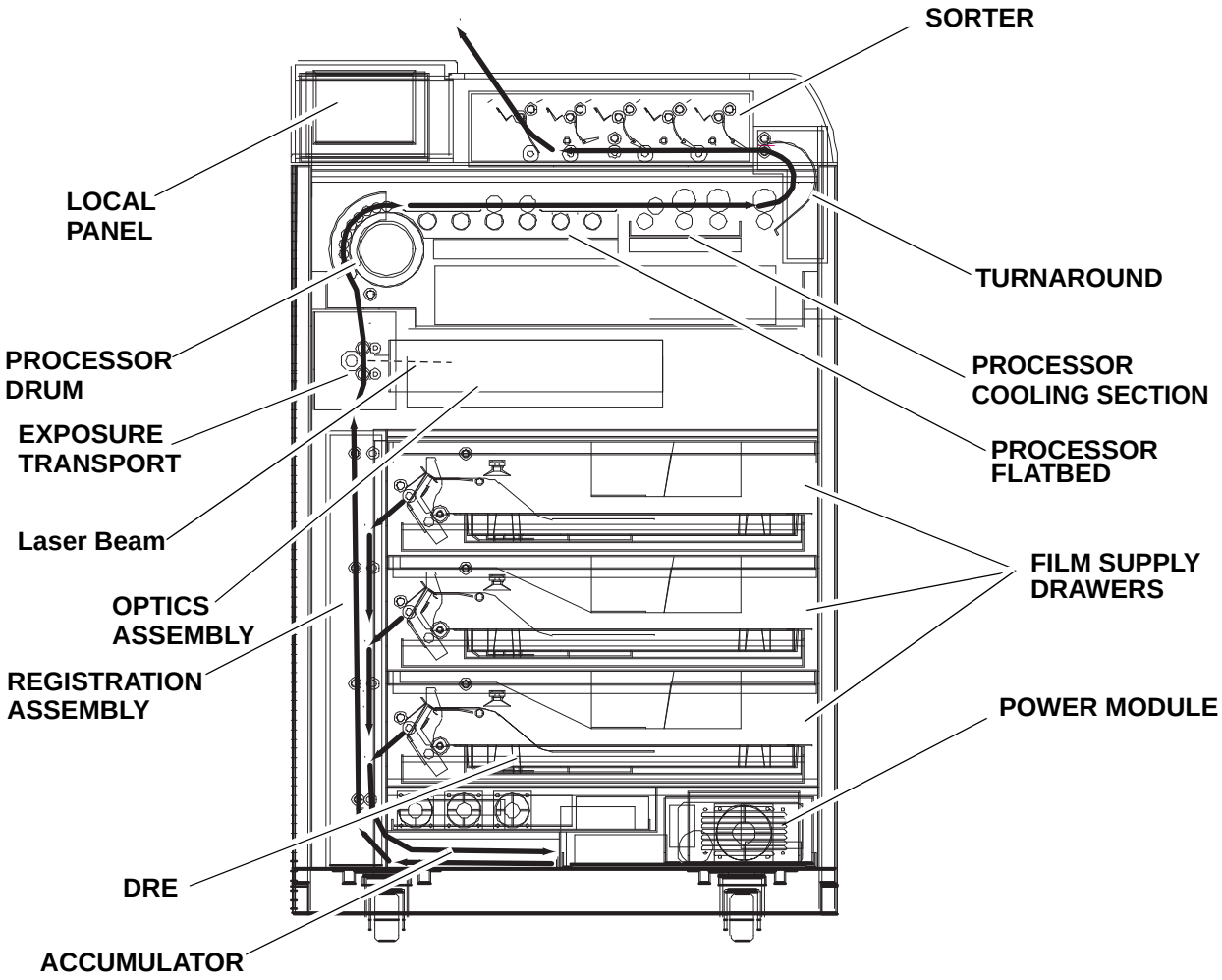
Section 1: Equipment Description

System Overview

Main Assemblies

Figure 1 shows the main parts of the IMAGER:

Figure 1

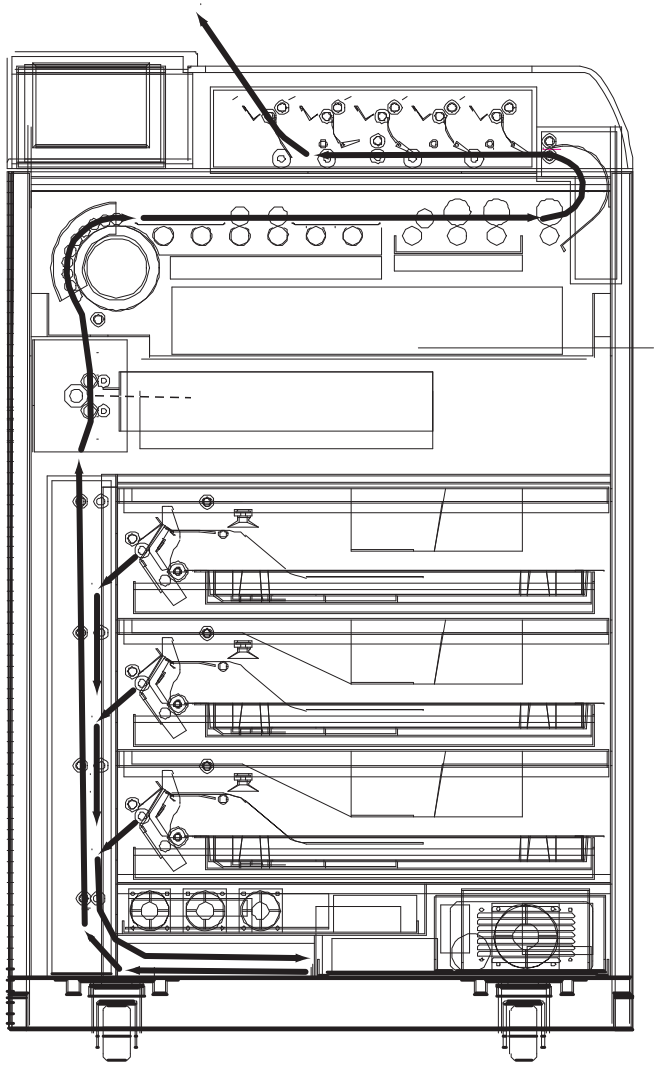


FILM SUPPLY DRAWERS	Each DRAWER holds a film cartridge. The PICKUP ASSEMBLY in the DRAWER feeds film to the REGISTRATION ASSEMBLY. There can be 1,2 or 3 DRAWERS.
REGISTRATION ASSEMBLY	Orients film for the EXPOSURE TRANSPORT.
EXPOSURE TRANSPORT	Moves the film line by line past the scanning laser beam.
OPTICS MODULE	Generates a scanning laser beam that exposes the film.
PROCESSOR DRUM	Rapidly heats the film to processing temperature.
PROCESSOR FLATBED	Keeps the temperature of the film until image is fully developed.
PROCESSOR COOLING SECTION	Stops emulsion development and hardens the “base”.
TURNAROUND	Routes developed film to the SORTER or OUTPUT TRAY.
SORTER	Places film in 1 of 5 SORTER BINS. You can configure the IMAGER to route films from each connected MODALITY to a different BIN. The SORTER is optional. If the IMAGER does not have a SORTER, all completed films are sent to 1 OUTPUT TRAY.
- DICOM RASTER ENGINE	A computer that runs the MIM software and the MACHINE CONTROL SYSTEM (MCS) software that controls the IMAGER.

Film Path

Figure 2 shows the film path within the IMAGER.

Figure 2



Main Steps in the Film Path

1. The MCS places an image into the IMAGE MEMORY on the DATAPATH BOARD.
2. One of the PICKUP ASSEMBLIES feeds a sheet of film to the REGISTRATION AY.
3. ROLLERS in the REGISTRATION AY move the film down until the trailing edge of the film clears the PICKUP AY and is vertical. Depending on the size of the film and the film DRAWER it comes from, the film might or might not extend all the way into the ACCUMULATOR.
4. ROLLERS in the REGISTRATION AY reverse direction and feed film from the ACCUMULATOR.
5. The film is “centered” and “deskewed” in the REGISTRATION AY.
6. ROLLERS in the REGISTRATION AY feed film up to the EXPOSURE TRANSPORT.
7. The DATAPATH BOARD starts to read the image from IMAGE MEMORY “line-by-line” and sends each line to the OPTICS MODULE. The OPTICS MODULE generates a scanning laser beam for each image line.
8. ROLLERS in the EXPOSURE TRANSPORT move the film past the horizontal scanning laser beam that exposes the film.
9. The leading edge of the film reaches the heated PROCESSOR DRUM and starts to develop when the “lower” part of the film is moving through the EXPOSURE TRANSPORT.
10. The film is moved through the THERMAL PROCESSOR by the rotating DRUM and a series of ROLLERS. In the PROCESSOR:

    - The DRUM rapidly heats the film to about 129 °C.

    - The film then moves through the heated FLATBED SECTION which maintains a slightly lower temperature and completes processing the film.

    - The film moves through the COOLING SECTION to remove heat from the film to prevent density variations.

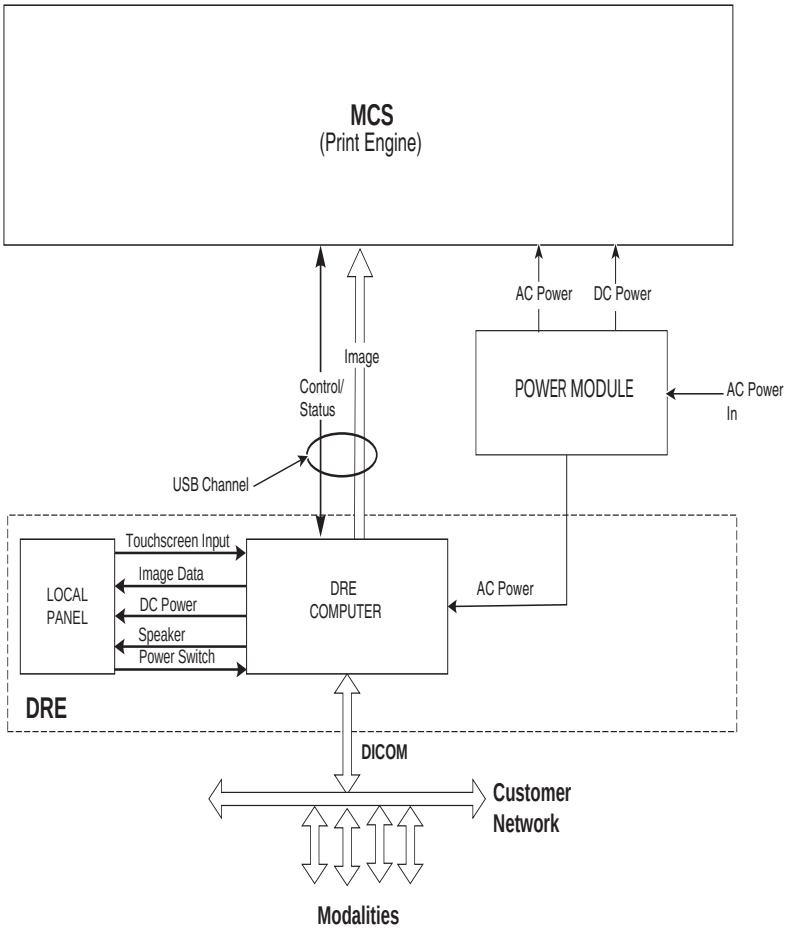
11. The developed film enters the TURN-AROUND which changes the film direction and discharges it to the SORTER or EXIT TRAY.

System Organization

Overview

The IMAGER has 3 main parts:

- The DICOM RASTER ENGINE (DRE)
- The MACHINE CONTROL SYSTEM (MCS)
- The POWER MODULE



DICOM RASTER ENGINE (DRE)

The DRE system consists of the DRE COMPUTER and the LOCAL PANEL.

The DRE COMPUTER is a compact Pentium PC that runs the *Microsoft Windows XP* operating system and several modules of the 6800 application software. With the application software, the DRE functions as a MIM print server, within the IMAGER, where the MCS is the print destination.

The DRE COMPUTER is responsible for acquiring print jobs from modalities on the customer's network and for queueing and rendering the incoming print jobs. Formatted print jobs are forwarded, over a USB connection, to the MCS for printing. The DRE COMPUTER also communicates with the LOCAL PANEL and runs service tool software that can be accessed with a SERVICE PC.

The LOCAL PANEL is an 8 by 10-in. color FLAT PANEL DISPLAY that serves as the operator interface for the IMAGER. In addition to the DISPLAY, it includes a TOUCHSCREEN, a SPEAKER and a POWER SWITCH. Images displayed on the LOCAL PANEL are sent from the DRE COMPUTER and TOUCHSCREEN commands are sent to the DRE COMPUTER for interpretation and action.

MCS

The MCS is the "print engine" within the IMAGER. It receives formatted images from the DRE and performs all of the electrical and mechanical functions necessary to transport, expose and develop *DryView* film.

Power Module

The POWER MODULE supplies +5 V and +24 V DC power to the MCS electronics and 120 V AC power to the DRE and to the HEATERS in the THERMAL PROCESSOR. Input power can range from 90 to 250 V AC. For energy saving purposes, the POWER MODULE includes a control input that allows the DRE COMPUTER to shut off DC power to the MCS electronics and AC power to the THERMAL PROCESSOR HEATERS.

For more information see **POWER MODULE**.

Section 2: DICOM RASTER ENGINE (DRE)

The DRE is a PERSONAL COMPUTER (PC) with the *Microsoft Windows XP Embedded* operating system. It runs application software that functions as a MIM PRINT SERVER and software that prepares images for printing.

The DRE connects to the customer's LOCAL AREA NETWORK and is responsible for acquiring, queueing and rendering images from DICOM modalities on the LAN. Rendered images are sent to the MCS for printing.

A single USB cable connects the DRE to the MCS. The USB interface can transfer several channels of data simultaneously. It concurrently transfers commands, image data and configuration from the DRE to the MCS. At the same time it transfers and status information and diagnostic information returned from the MCS.

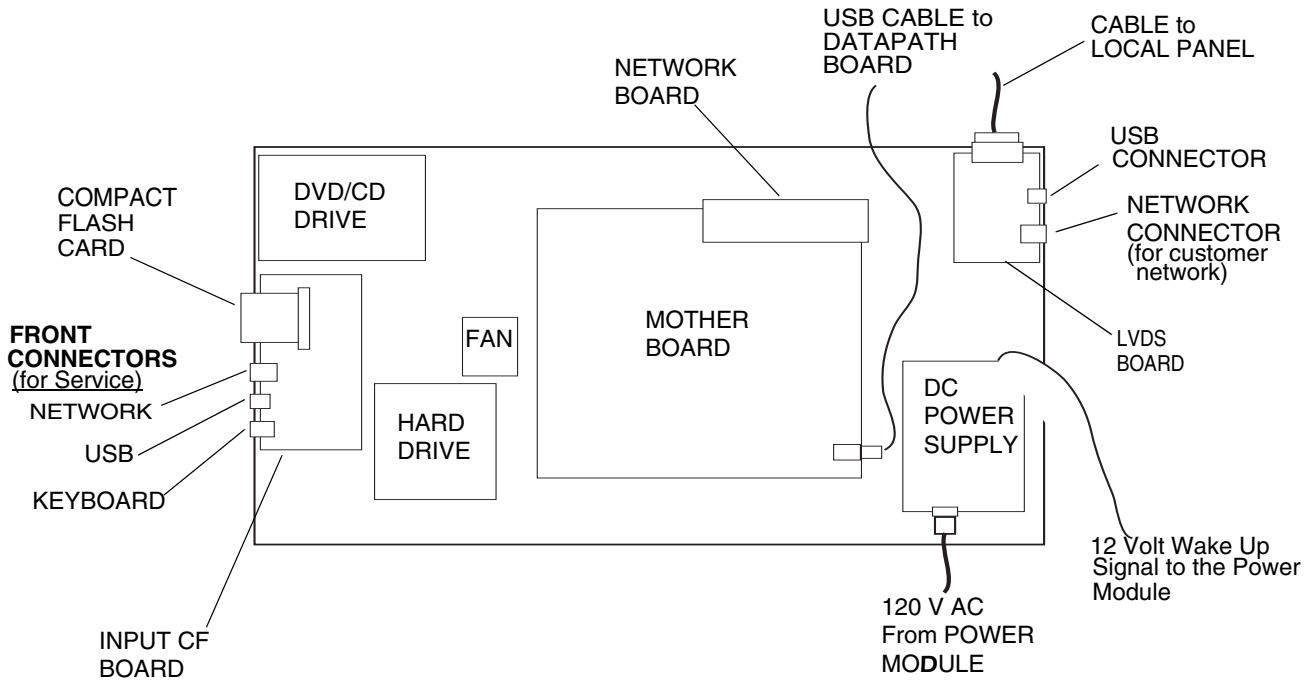
The DRE is mounted on a tray that slides out of the IMAGER for service. The main components are

- PC MOTHERBOARD with a 1.6 GHz (or better) *Intel Pentium M* PROCESSOR
- A NETWORK BOARD in a PCI slot on the MOTHERBOARD
- HARD DRIVE
- DVD/CD DRIVE
- DC POWER SUPPLY for the MOTHERBOARD and accessories
- Cooling FAN
- INPUT CF BOARD - This BOARD performs 2 functions
  - It provides an adaptor for a COMPACT FLASH (CF) CARD that connects to the IDE controller on the MOTHERBOARD.
  - It provides a service interface to the DRE. There are 3 CONNECTORS for service tools:
    > An RJ45 NETWORK CONNECTOR to connect a LAPTOP COMPUTER
    > A USB CONNECTOR for connecting a USB MOUSE
    > A PS2 CONNECTOR for connecting a KEYBOARD

- LVDS BOARD -This BOARD provides an interface between the MOTHERBOARD and the LOCAL PANEL. It also provides 2 external connectors:
  - An RJ45 NETWORK CONNECTOR for connecting the IMAGER to the customer's Ethernet/DICOM network
  - A USB CONNECTOR for future use

A 26-pin cable connects the LVDS BOARD to the LOCAL PANEL. This cable carries the image data for the LCD PANEL, input data from the TOUCH SCREEN, backlight brightness signal, audio for the SPEAKER, +3.3, +5 and +12 V DC power, and a signal from the POWER BUTTON on the LOCAL PANEL. LVDS is an abbreviation for "Low Voltage Differential Signaling", the transmission method used to send image data from the LVDS BOARD to the LOCAL PANEL.

The following diagram shows the main components in the DRE and the external connection points on the DRE.



The COMPACT FLASH (CF) CARD is used to backup and restore the IMAGER configuration parameters. It also holds data required for startup and should not be removed or replaced unless directed by a MODIFICATION INSTRUCTION or other approved procedure. The IMAGER will not start up if the CF CARD is not present.

The DC POWER SUPPLY in the DRE supplies power to the MOTHER BOARD, HARD DRIVE and DVD/CD DRIVE. A 12 V DC output from the DRE POWER SUPPLY serves as a wake up signal to the IMAGER POWER MODULE.

The DRE POWER SUPPLY is controlled by the MOTHERBOARD. A logic signal from the MOTHERBOARD turns the DRE POWER SUPPLY ON and OFF.

- When the IMAGER is “Ready” or in the “Energy Save” or “Sleep” modes, the MOTHERBOARD turns the DRE POWER SUPPLY ON. The POWER SUPPLY provides +3.3, +5, +12, and -12 V DC and the DRE is fully functional.
- When the IMAGER is in the “Power Off” state, the MOTHERBOARD turns off the DRE POWER SUPPLY. In this condition, the POWER SUPPLY provides only +5 V DC standby power to the MOTHERBOARD. Most functions on the MOTHERBOARD are suspended but the 5V standby power enables the MOTHERBOARD to wakeup with a signal from the POWER BUTTON on the LOCAL PANEL or from the Power Schedule set up on the LOCAL PANEL.

Note

The DRE POWER SUPPLY receives 120 V AC input power from the POWER MODULE. The POWER SWITCH on the POWER MODULE must be ON for the DRE POWER SUPPLY to supply either full power or +5 V standby power.

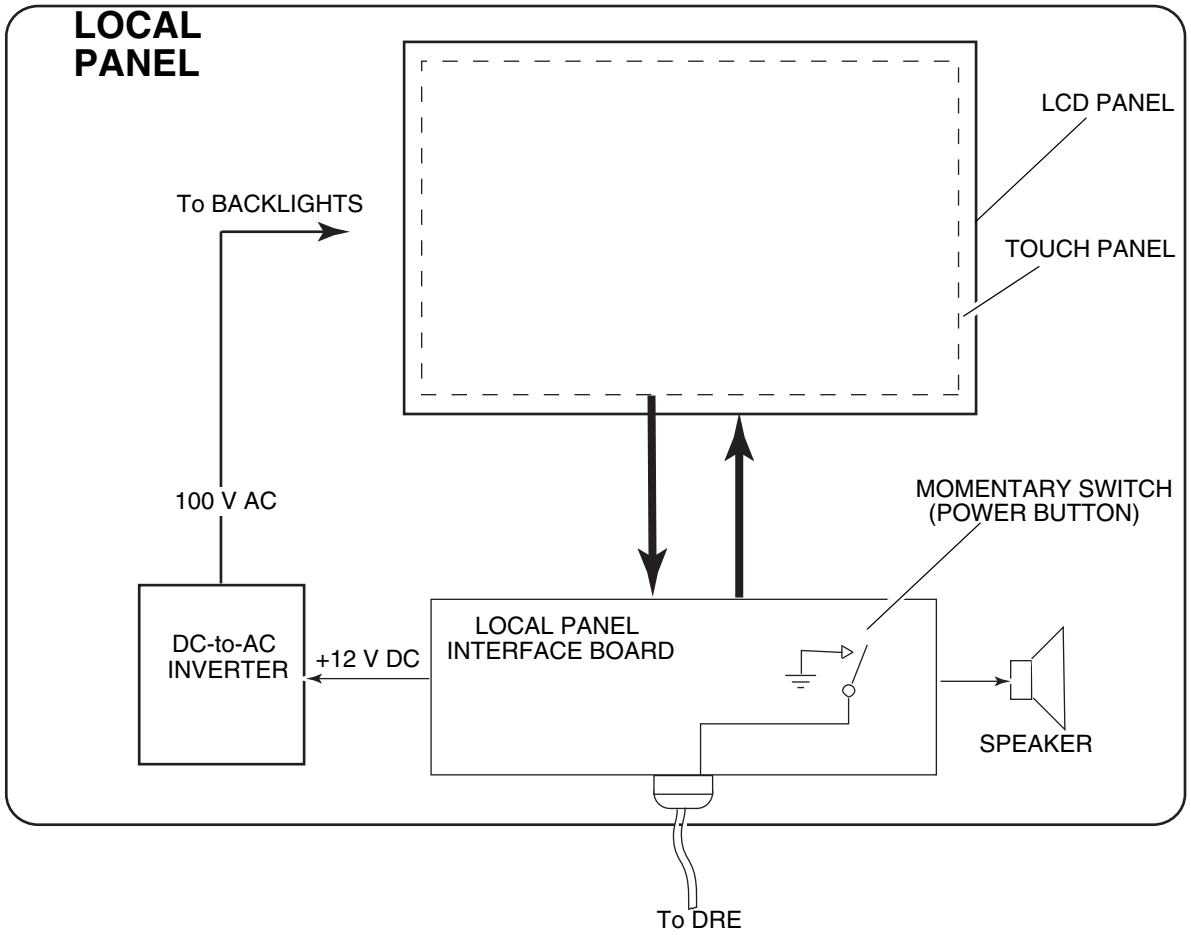
Section 3: Local Panel

The LOCAL PANEL, which connects by a CABLE to the LVDS BOARD in the DRE, contains:

- An LCD DISPLAY with miniature fluorescent BACKLIGHTS
- A TOUCH PANEL
- An DC-to-AC INVERTER POWER SUPPLY for the BACKLIGHTS
- A SPEAKER
- A momentary POWER SWITCH
- A LOCAL PANEL INTERFACE BOARD that connects to the to the LVDS BOARD in the DRE

The LOCAL PANEL is not repaired in the field: it is replaced as a unit.

The following graphic is a block diagram of the LOCAL PANEL.



The cable that connects the LOCAL PANEL to the DRE carries:

- Image data for the LCD DISPLAY PANEL
- Input data from the TOUCH PANEL
- Closure signal (ground) from the MOMENTARY SWITCH
- Audio signal to the SPEAKER
- A backlight dimming signal
- +3.3, +5, and +12 V DC power

Section 4: Machine Control System (MCS)

The MCS is the print engine within the IMAGER. It is made up of both hardware and software components.

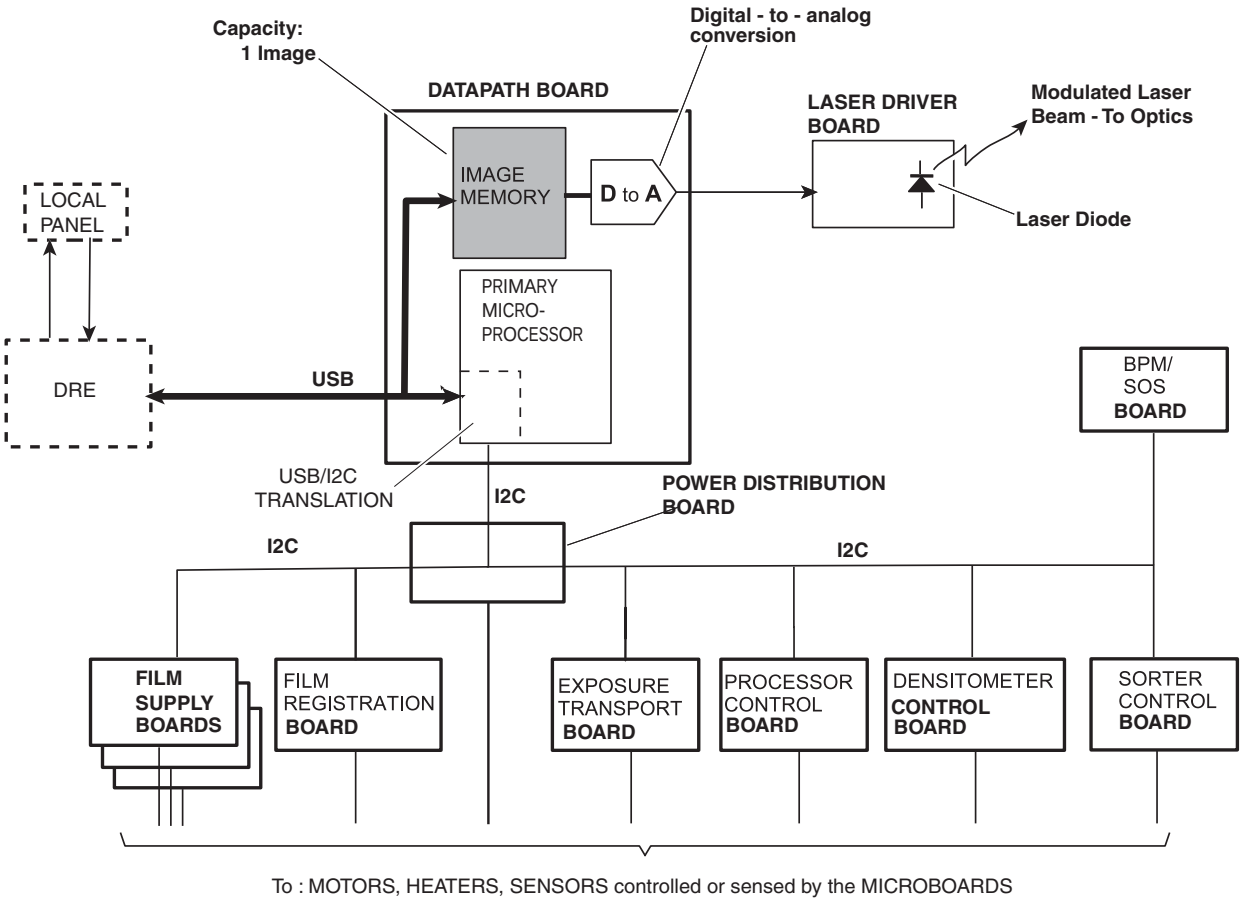
MCS Functions

The MCS receives image data and commands from the DRE over the USB interface and is responsible for controlling the mechanical and optics assemblies to transport, expose and develop films. Once the DRE sends an image and print command, the MCS performs the actions necessary to expose and print a film largely independent of the DRE.

MCS Hardware

The MCS hardware consists of several electro-mechanical subsystems, each controlled by a “MICRO BOARD” - a circuit board containing a MICROPROCESSOR. Software in each MICRO BOARD provides the control “intelligence” for the subsystems. An I2C BUS connects a master MICROPROCESSOR on the DATAPATH BOARD to all of the other MICRO BOARDS. The BUS is used to exchange commands and status information between the master MICROPROCESSOR and the MICROROCESSORS on the other MICRO BOARDS. The master MICROPROCESSOR controls the subordinate MICROBOARDS by sending commands and receiving status information on the I2C BUS. Each MICROBOARD controls the functions of its mechanical subsystem by controlling motors and reading sensors.

The following diagram shows how the MICROBOARDS are connected on the I2C BUS. The DATAPATH MICROPROCESSOR is the primary control device with all other MICROPROCESSORS subordinate.



I^2C BUS

The I^2C is a low-speed, serial BUS with only 2 lines (plus ground). The BUS interconnects all of the MICROBOARDS.The MICROCONTROLLERS and FLASH MEMORIES on the MICROBOARDS connect to the BUS. Each device connected to the BUS has a unique address.

The BUS is bidirectional. Any of the MICROPROCESSORS can initiate a data transfer on the BUS. Several types of information are transferred on the BUS:

- Commands - These are sent from the MASTER MICROPROCESSOR, on the DATAPATH BOARD, to cause a slave MICROPROCESSOR to perform an action, for example, to “Execute Diagnostics” stored in the slave CPU. A command causes the slave to reply, acknowledging that the command can be processed or that there is a problem which prevents processing the command.
- MICROBOARDS return responses to commands to the DATAPATH BOARD.
- MICROBOARDS send status information to the DATAPATH BOARD.
- Software updates are downloaded to the MICROBOARDS.

Communication Between MICRO BOARDS

Communication between the DRE and the 11 MICRO-BOARDS is conducted over a USB channel and an I2C bus. The 11 MICRO-BOARDS are all connected on a common I2C bus. This bus is used to send commands from the DRE to the MICRO-BOARDS and return responses from the MICRO-BOARDS. It is also used to load software or other data into MICROPROCESSOR MEMORIES or NVRAM on the MICRO-BOARDS.

The I^2C INTERFACE is a 2-wire BUS having a Serial Data, SDA, and a Serial Clock (SCL) line. These wires connect information between the devices and the CPUs connected to the BUS. Each CPU on the BUS is recognized by a unique address and can either receive or transmit data. The CPU that starts a data transfer is a “master” and the receiving CPU is a “slave.” Any of the CPUs on the BUS can be either a master or a slave. In practice, the MASTER CPU will start all commands, and will normally be the master, and the CPUs for modules on the BUS will be slaves. Three types of messages are used:

- Commands - These are sent from the MASTER CPU to cause a slave CPU to perform an action, for example, to “Execute Diagnostics” stored in the slave CPU. A command causes the slave to reply, acknowledging that the command can be processed or that there is a problem which prevents processing the command.
- Replies - The slave must respond with a reply after each byte of a received command. If the MASTER does not receive a reply within 100 ms after sending the command, it will stop the process.

- Notification - These are sent from a slave CPU to the MASTER CPU indicating a changed condition in the slave module.

Each type of message must be preceded by the address of the CPU for which it is intended.

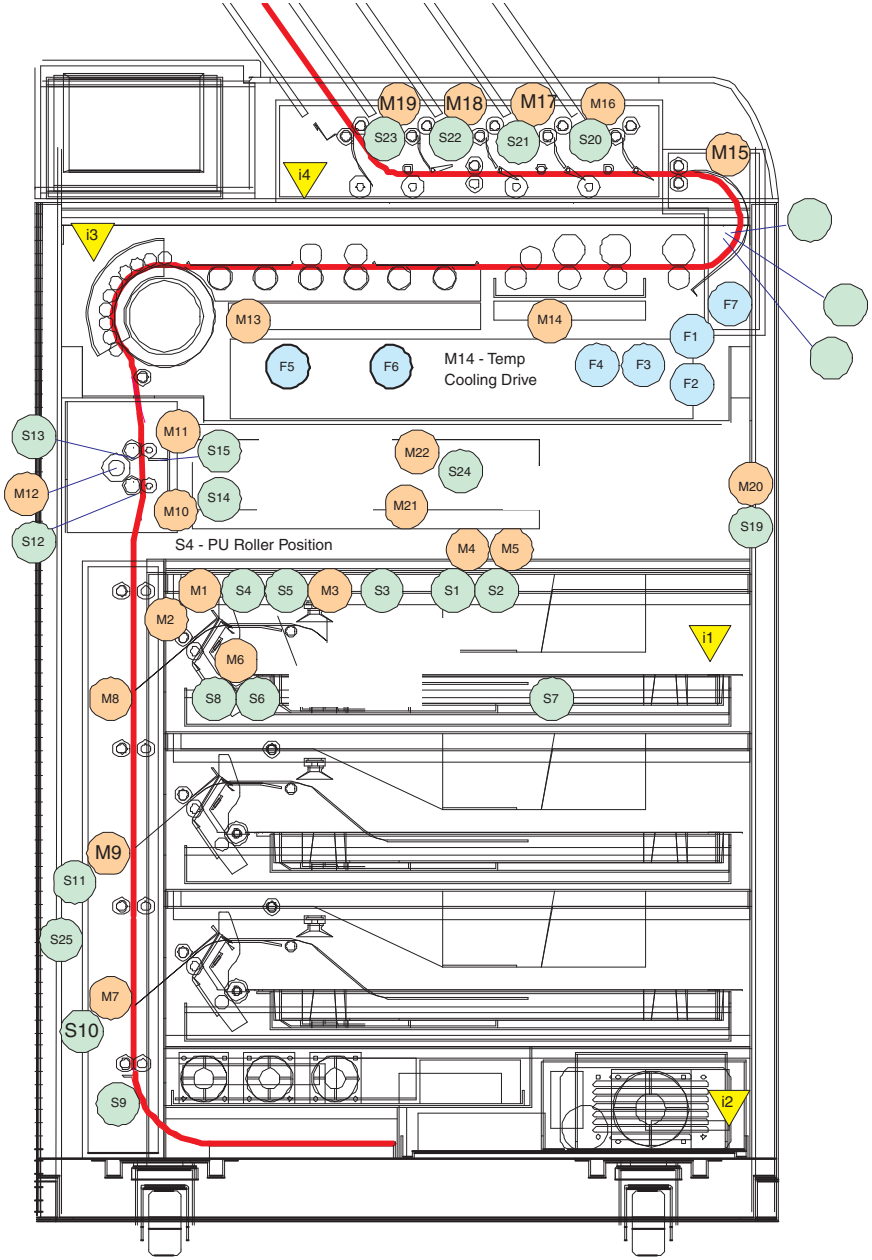
Optics Module

Components Controlled or Sensed by the MICROBOARDS

The IMAGER has a number of rotary and linear MOTORS that power the functions of the IMAGER and SENSORS. The SENSORS provide input to MICROPROCESSORS that control the MOTORS.

Figure 3 shows the approximate location of MOTORS and SENSORS in the IMAGER. Table 1 and Table 2 provide descriptions each MOTOR and SENSOR.

Figure 3 **MOTORS and SENSORS**



Note

In the following tables: For components in the PICKUP or ROLLBACK ASSEMBLIES, x will be U, M or L, for the UPPER, MIDDLE or LOWER FILM DRAWER.

Table 1 MOTORS

Designator/ Location	Name	Location	Description/ Function	Motion	Type	Home/ Default	Limit
M1x Pickup	PICKUP FEED ROLLER OPEN/ CLOSE MOTOR	PICKUP	ROLLER Open/ Close	Rotational	DC GEAR MOTOR	Home = Open	Limit = Close
M2x Pickup		PICKUP	ROLLER drive	Rotational	STEPPER	Off	On
M3x Pickup		PICKUP	PICKUP drive	Rotational	DC GEAR MOTOR	Home = Up (film at feed)	Limit = Cartridge bottom
M4x Pickup		PICKUP	PICKUP PUMP	Rotational			
M5x Pickup		PICKUP	PICKUP RELIEF VALVE	Linear			
M6 Rollback		ROLLBACK	ROLLBACK DRIVE MOTOR				
M7 Registration		Registration	Centering MOTOR	Rotational, Reversing	STEPPER	Home = ARMS retracted	actuated = ARMS extended to film size

Table 2 SENSORS

Designator	Location	Description/ Function	Type	Default	Sensed Position
S1x	PICKUP	Home SENSOR	Interrupt SENSOR	Blocked = PICKUP home	Unblocked = PICKUP not home

Section 5: POWER DISTRIBUTION BOARD

Functions

The POWER DISTRIBUTION BOARD (PDB) performs several functions:

- Distributes +5 volt and +24 volt DC power to all other CIRCUIT BOARDS except the DRE and LOCAL PANEL.
- Provides the logic for the system
- Connects the I2C bus to all of the MICRO BOARDS
- Controls the LATCH MOTOR that unlocks the front DOORS and FILM DRAWERS
- Controls the TURNAROUND MOTOR

Figure 4 on page Page 24 is a block diagram of the PDB.

Power Distribution

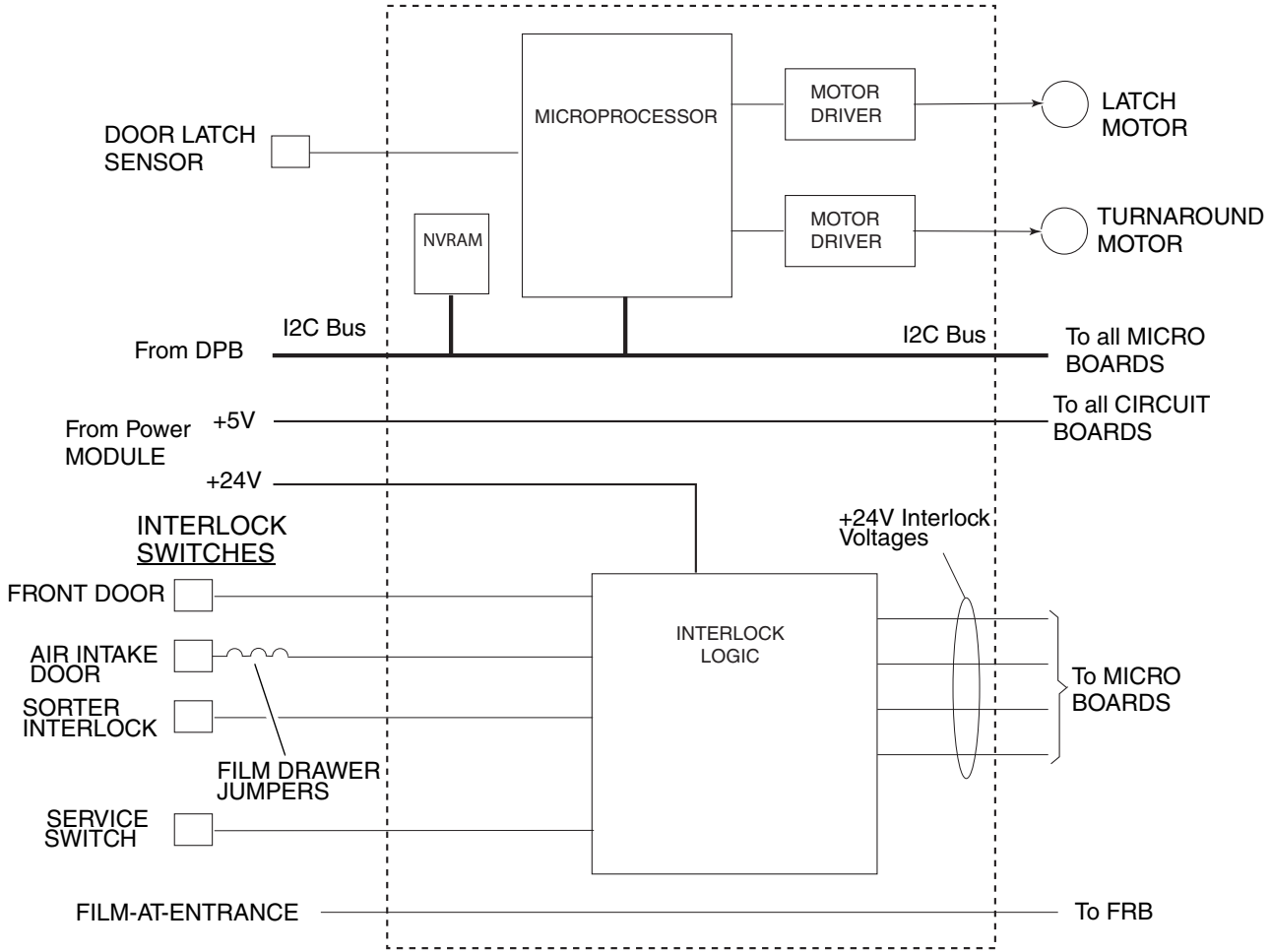
The POWER MODULE supplies +5-volt and +24-volt DC power to the PDB. The PDB provides +5-volt power, either directly or indirectly, to all CIRCUIT BOARDS except the DRE and LOCAL PANEL. There is no switching or control of +5-volt power on the PDB.

The PDB provides +24-volt power to the MICRO BOARDS subject to inputs from the INTERLOCK SWITCHES or SERVICE SWITCH. The logic on the PDB may interrupt +24-volt power to some or all of the MICRO BOARDS depending on the inputs.

I2C Bus

The PDB provides I2C bus connections between the DPB and all the other MICRO BOARDS. The I2C bus simply passes through the PDB. There is no control or switching of the bus on the PDB.

Figure 4 **PDB Block Diagram**



MICROPROCESSOR FUNCTIONS

The MICROPROCESSOR in the PDB controls the DOOR LATCH MOTOR and the TURNAROUND MOTOR. The MICROPROCESSOR receives an input from the DOOR LATCH SENSOR and connects to the 2 MOTOR DRIVERS that energize the 2 MOTORS.

The output of the DOOR LATCH SENSOR is low when the FRONT DOOR is locked and high when the DOOR is unlocked.

Application Software

Application software that runs in the MICROPROCESSOR communicates with the MCS software to control the 2 MOTORS and report status to the MCS. The application software also performs initialization tests upon power-up, when a reset command is received from the MCS or when the RESET SWITCH on the PDB is pressed. The application software performs MOTOR diagnostic tests and memory tests when the MCS sends diagnostic commands.

Door Latch Motor

The DOOR LATCH MOTOR is a linear stepper MOTOR that, when energized, lifts a LATCH ROD. that locks and unlocks the FRONT DOOR and DRAWERS.

The LATCH ROD has 2 positions: up and down. When the ROD is down, the FRONT DOOR and the FILM DRAWERS are locked and the PROCESSOR DRAWER is unlocked (but secured by latches on the DRAWER SLIDES). When the ROD moves up, it unlatches the FRONT DOOR. The DOOR remains unlatched until it is pushed closed. If the ROD is held up, the FILM DRAWERS are unlocked but the PROCESSOR DRAWER is locked. This mechanism prevents the FILM DRAWERS and PROCESSOR DRAWER from being pulled out at the same time.

Note

The LATCH ROD can be operated manually from inside the AIR INTAKE DOOR.

Unlock Functions

In response to commands from the MCS, the application software controls the DOOR LATCH MOTOR to perform the following unlock functions.

- When “Unlock Film Supply” is selected on the LOCAL PANEL, the LATCH MOTOR lifts and holds the LATCH ROD up. The FRONT DOOR and FILM DRAWERS are unlocked but the PROCESSOR DRAWER is locked. The LATCH MOTOR holds the ROD up until the FRONT DOOR is closed.

- When “Unlock Processor” is selected on the LOCAL PANEL, the LATCH MOTOR lifts the ROD briefly to unlatch the FRONT DOOR then immediately lowers the ROD to lock the FILM DRAWERS. The FRONT DOOR can be opened and the PROCESSOR DRAWER can be pulled out.

Turnaround Motor

The TURNAROUND MOTOR is a rotary stepper MOTOR that drives ROLLERS in the TURNAROUND that move film to the SORTER or OUTPUT TRAY. Application software in the PDB MICROPROCESSOR operates the TURNAROUND MOTOR in response to commands from the MCS:

1. When a film is exiting the EXPOSURE TRANSPORT, the MCS notifies the PDB application to “Transport Film to the Densitometer”.
2. A software timer is started to track the progress of film through the PROCESSOR and toward the TURNAROUND ROLLERS.
3. When the timer indicates that the film is approaching the first TURNAROUND ROLLER, the application runs the TURNAROUND MOTOR at the same speed as the PROCESSOR.
4. When the film passes the DENSITOMETER FILM PRESENT SENSOR, S18, the application delays until the trailing edge of film clears the COOLING SECTION ROLLERS and then runs the TURNAROUND MOTOR at high speed to “kick” the film out of the TURNAROUND.
5. The application allows time for the film to exit to the SORTER or OUTPUT TRAY and then turns off the TURNAROUND MOTOR.

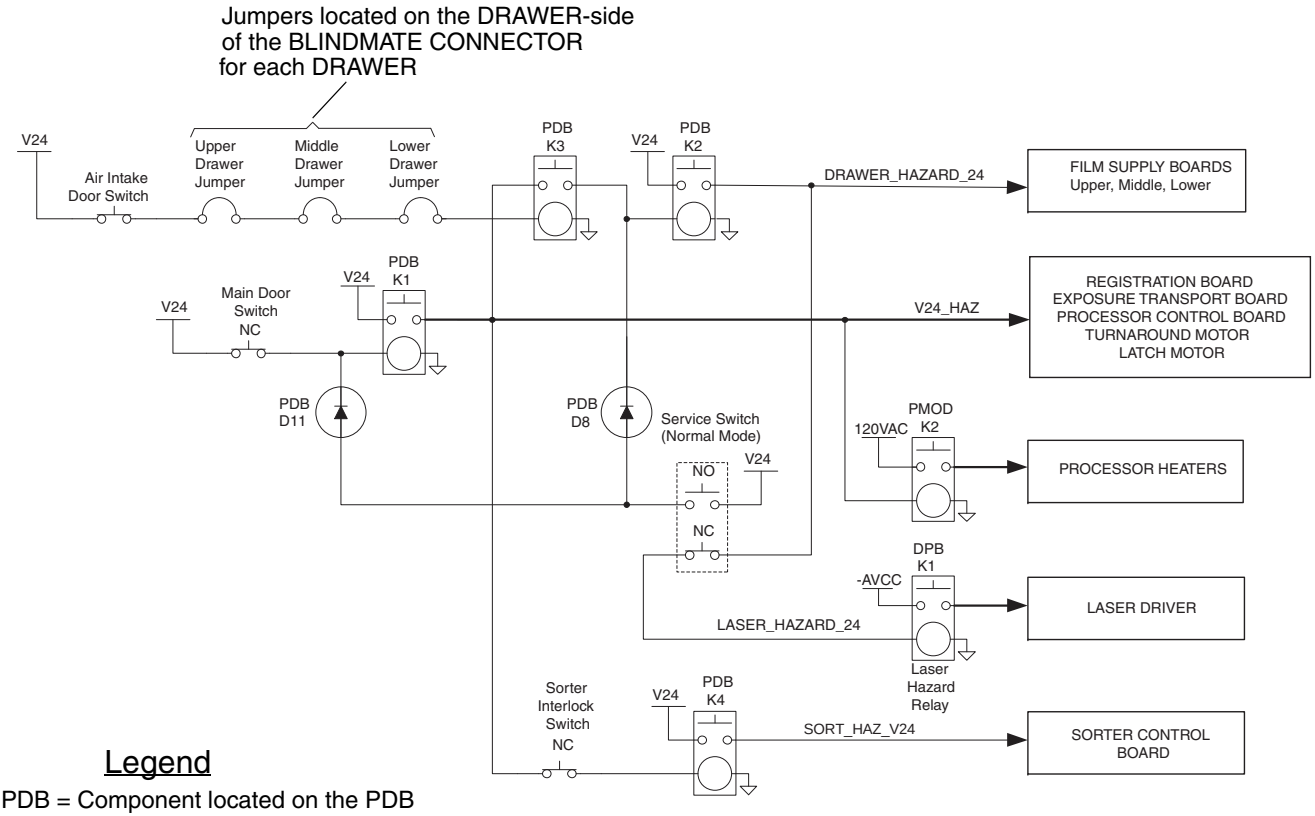
Note

If the film is a calibration sheet, the high-speed “kick” is not started while the film is in the densitometer.

INTERLOCK SYSTEM

Figure 5 is a simplified diagram of the Interlock circuits. All INTERLOCK SWITCHES must be closed for the IMAGER to operate normally. Table 3 on Page 28 shows the effect of opening each INTERLOCK SWITCH.

Components in the INTERLOCK SYSTEM are located on the PDB, the PCB, the DPB and in the POWER MODULE. For details of cabling between the INTERLOCK SWITCHES and other interlock components, refer to the FUNCTIONAL BLOCK DIAGRAMS for the IMAGER.



Legend

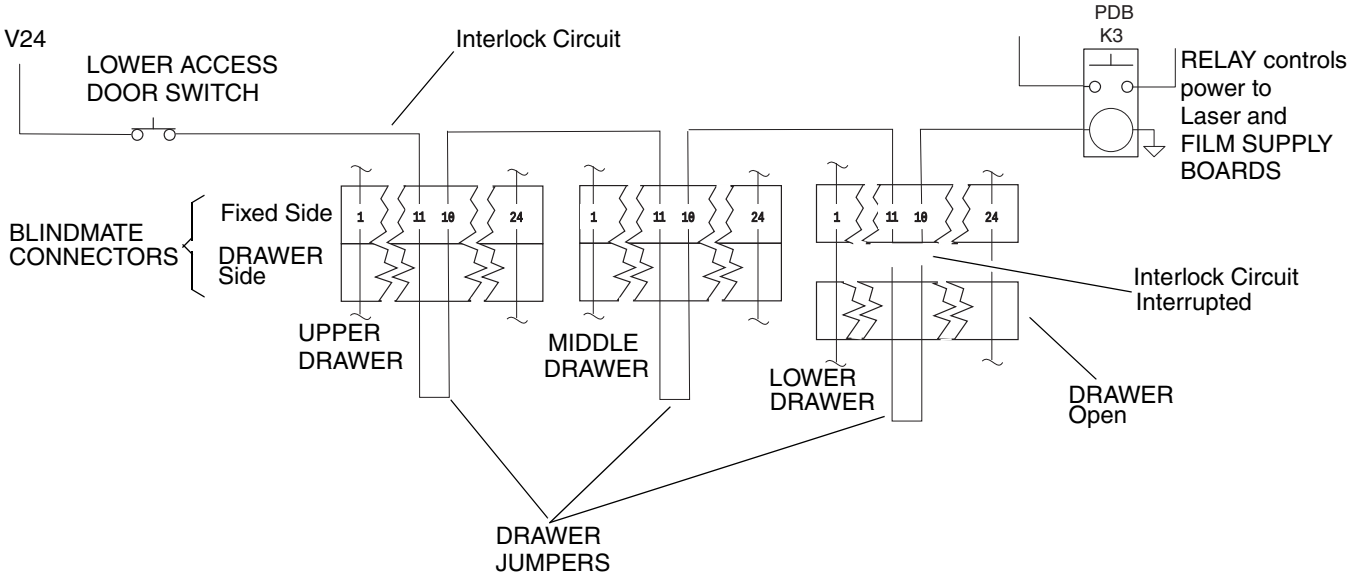
PDB = Component located on the PDB
PMOD = Component located in the POWER MODULE
DPB = Component located on the DPB
V24 = + 24 volts DC
-AVCC = -5volts DC for analog circuits
120V AC = 120 volts AC for PROCESSOR HEATERS

Table 3 INTERLOCK SWITCH ACTIONS

INTERLOCK SWITCH and Condition	SORTER DIVERTERS	TURNAROUND/ EXPOSURE TRANSPORT/ PROCESSOR/ REGISTRATION/ LATCH MOTOR	FILM SUPPLY	120VAC POWER to PROCESSOR	LASER
MAIN DOOR - Open	OFF	OFF	OFF	OFF	OFF
SORTER - Open	OFF	ON	ON	ON	ON
Any DRAWER - Open	ON	ON	OFF	ON	OFF
AIR INTAKE DOOR - Open	ON	ON	OFF	ON	OFF
SERVICE SWITCH - in Service Mode	ON	ON	ON	ON	OFF
All SWITCHES Closed - Normal Mode	ON	ON	ON	ON	ON
SERVICE SWITCH Unplugged	ON	ON	ON	ON	OFF

FILM DRAWER INTERLOCK JUMPERS - The BLINDMATE CONNECTOR on each FILM DRAWER has a JUMPER that acts as an INTERLOCK SWITCH when the DRAWER is opened. Figure 6 on Page 32 shows how these JUMPERS are connected. If either the LOWER DOOR ACCESS SWITCH or any of the FILM DRAWERS are open, the interlock circuit is broken and power to the LASER DRIVER BOARD and FILM SUPPLY BOARDS is interrupted.

Figure 5


V24
LOWER ACCESS
DOOR SWITCH
Interlock Circuit
PDB
K3
RELAY controls
power to
Laser and
FILM SUPPLY
BOARDS
BLINDMATE
CONNECTORS
Fixed Side
DRAWER
Side
1
11
10
24
UPPER
DRAWER
MIDDLE
DRAWER
LOWER
DRAWER
Interlock Circuit
Interrupted
DRAWER
Open
DRAWER
JUMPERS

Section 6: ROLLBACK/PICKUP ASSEMBLIES

To Be Supplied

Section 7: Film Registration Assembly

PURPOSE

The purpose of the FILM REGISTRATION SUBSYSTEM is to orient a sheet of film for entry to the EXPOSURE TRANSPORT. The film is positioned so that:

- Notch is down
- Emulsion towards the OPTICS MODULE
- Film is “centered” on the EXPOSURE TRANSPORT ROLLERS.
- Film is “deskewed” - vertical edges of the film are aligned, parallel with film direction.

The FILM REGISTRATION SUBSYSTEM has:

- FILM REGISTRATION AY
- ACCUMULATOR
- FILM REGISTRATION CIRCUIT BOARD
- FILM REGISTRATION application software that runs in a MICROPROCESSOR on the FILM REGISTRATION BOARD

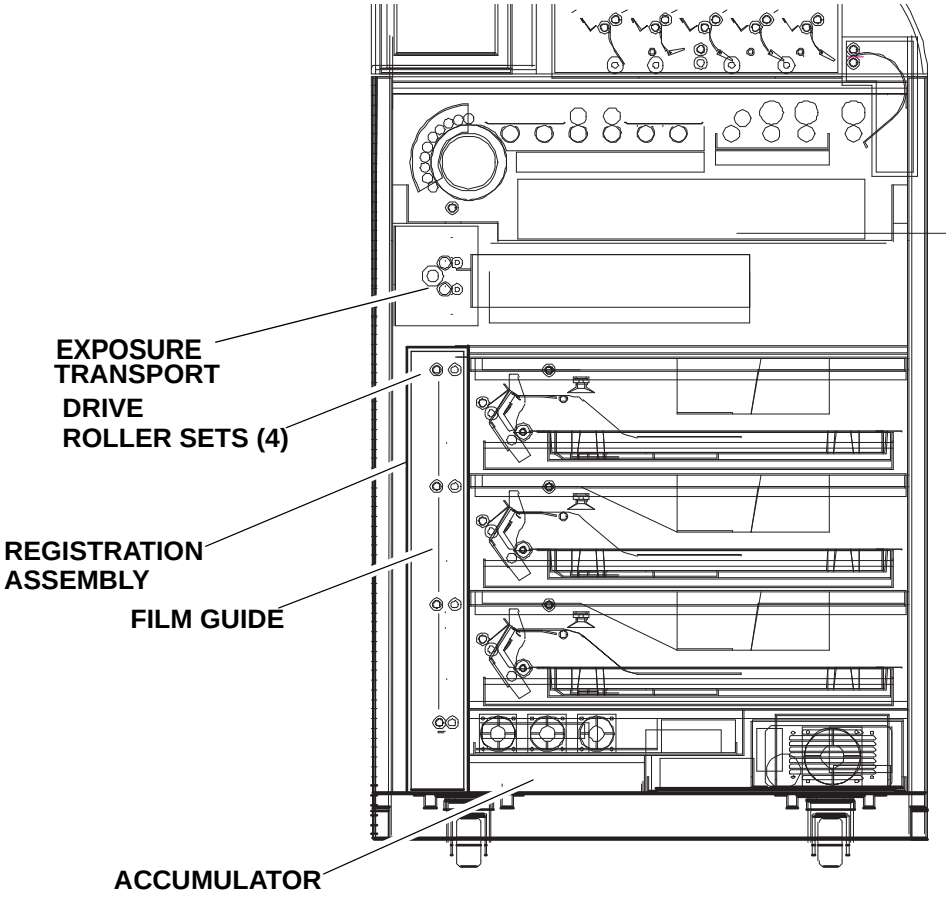
The FILM REGISTRATION BOARD is connected to a number of electrical components within the FILM REGISTRATION AY:

- VERTICAL TRANSPORT MOTOR - operates the 4 DRIVE ROLLERS.
- FILM CENTERING MOTOR - operates the CENTERING FINGERS.
- FILM CLAMPING MOTOR - opens and closes the NIP ROLLERS for the top 3 drive ROLLER pairs.
- HOME POSITION SENSOR for FILM CENTERING MOTOR
- HOME POSITION SENSOR for CLAMPING MOTOR
- FILM POSITION SENSOR in the ACCUMULATOR

The FILM REGISTRATION application controls film registration functions by operating the 3 MOTORS in the assembly, based on commands from the MCS and inputs from the 3 SENSORS in the FILM REGISTRATION AY.

The following drawing shows the position of the FILM REGISTRATION ASSEMBLY and ACCUMULATOR.

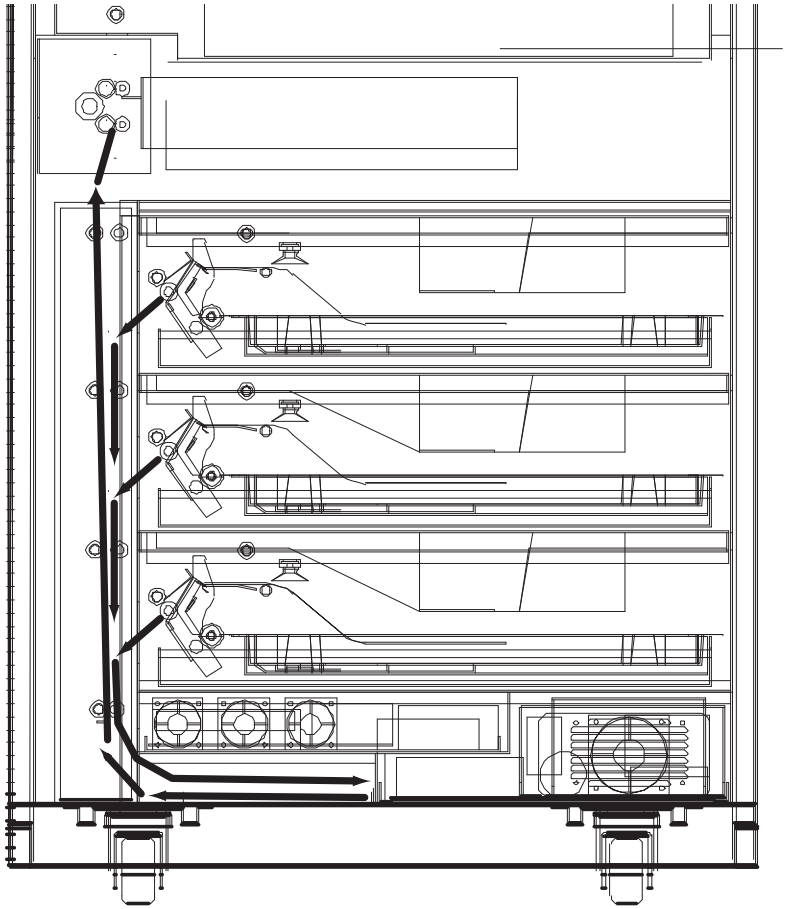
Figure 6



FILM PATH

Figure 7 shows the film path through the FILM REGISTRATION SUBSYSTEM.

Figure 7



REGISTRATION ASSEMBLY

The following 2 graphics show the main components in the FILM REGISTRATION AY.

Figure 8 **REGISTRATION ASSEMBLY - VIEW FACING FILM SUPPLY DRAWERS**

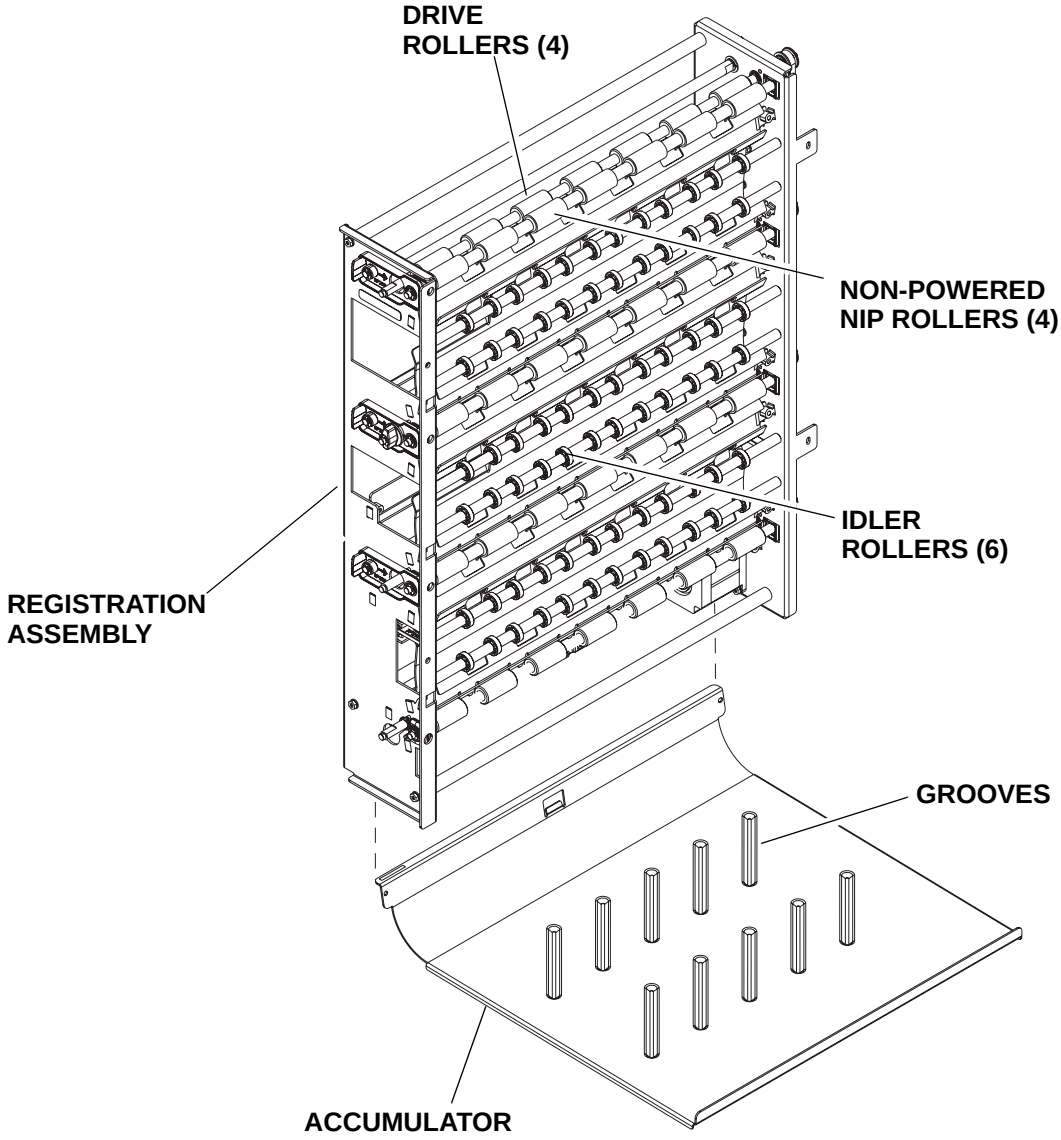
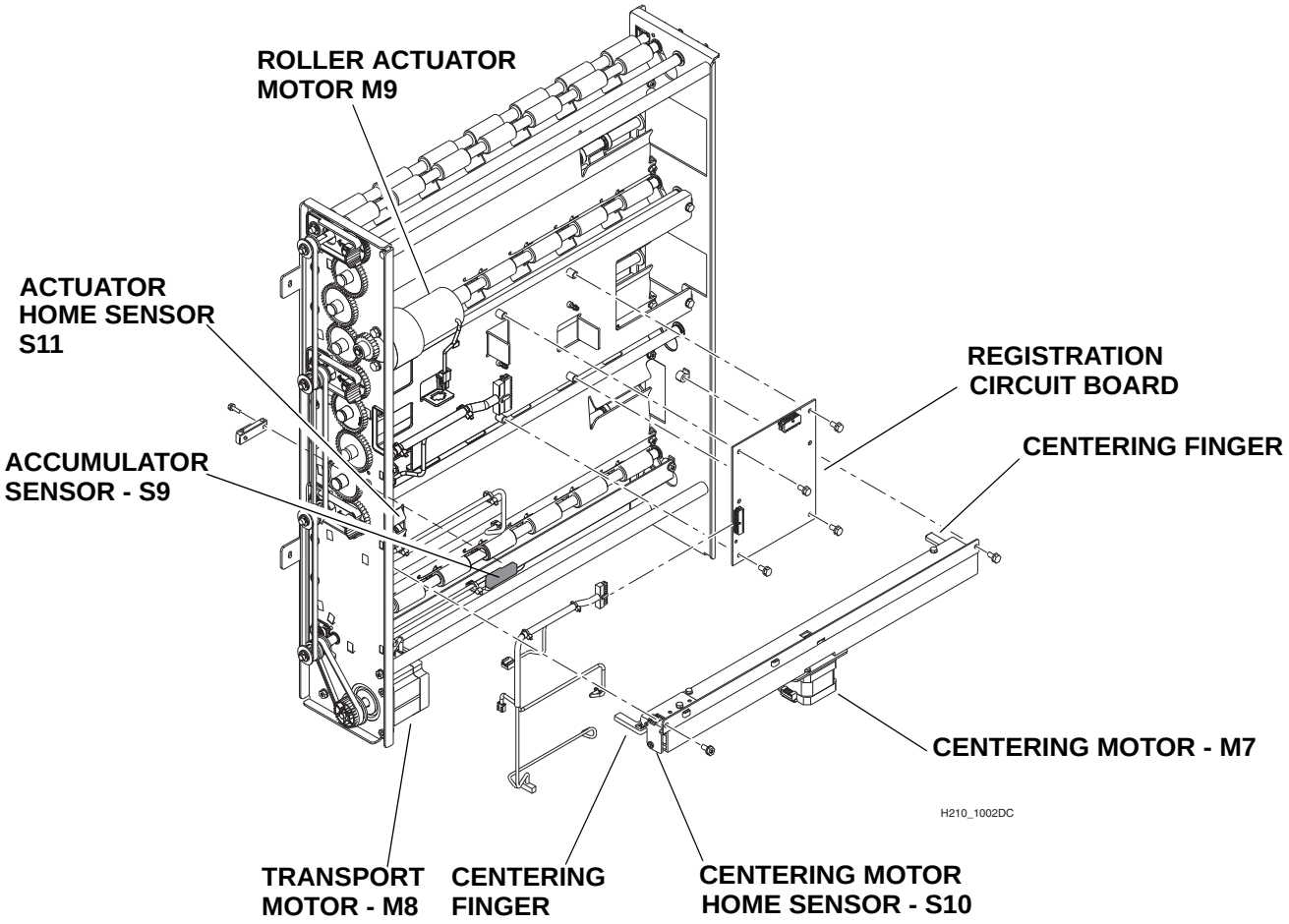


Figure 9 **REGISTRATION ASSEMBLY - VIEW TOWARD OUTSIDE OF IMAGER**



Registration Component Functions

- DRIVE ROLLERS - 4 pairs of ROLLERS transport the film down and then up to the EXPOSURE TRANSPORT. Each pair of ROLLERS has a “powered” ROLLER and a NIP ROLLER that is not “powered”. The top 3 NIP ROLLERS are opened and closed by the ROLLER ACTUATOR MOTOR. The bottom pair does not open.
- FILM GUIDES - *To be supplied*
- IDLER ROLLERS - *To be supplied*
- ACCUMULATOR - This TRAY “attaches” to the bottom of the REGISTRATION ASSEMBLY. It catches the film sheet at the end of the down path, before it is moved upward to the EXPOSURE TRANSPORT.
- TRANSPORT MOTOR - M8: Operates the 4 DRIVE ROLLERS.
- ROLLER ACTUATOR MOTOR - M9: Opens and closes the top 3 NIP ROLLERS.
- ACTUATOR HOME SENSOR - S11: Indicates if the NIP ROLLERS are open or closed.
- CENTERING MOTOR - M7: Operates the CENTERING FINGERS.
- CENTERING MOTOR HOME SENSOR - S10: Provides a signal when the CENTERING FINGERS are in the home position. Home is the fully extended position.
- CENTERING FINGERS - The 2 CENTERING FINGERS move in from each side to center the film within the REGISTRATION AY.
- ACCUMULATOR SENSOR - S9: **to be supplied**
- FILM REGISTRATION BOARD - Controls the Film Registration MOTORS.

Electrical Components

Figure 10 **FILM REGISTRATION Block Diagram**

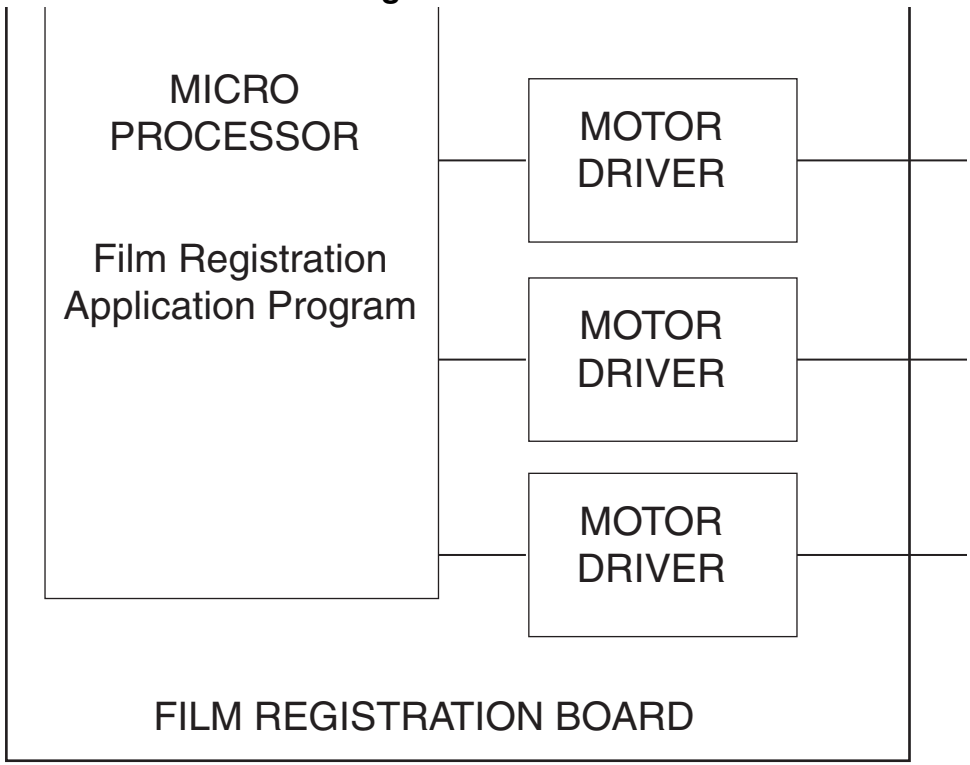


Figure 10 shows the electrical components in the FILM REGISTRATION SUBSYSTEM.

The MICROPROCESSOR runs the film registration application. With commands from the MCS and inputs from the 3 SENSORS, the application operates the 3 MOTORS to control the film registration process.

HOW THE REGISTRATION SUBSYSTEM FUNCTIONS

The following sequence shows the main steps in the film registration process. This process is controlled by the application program in the MICROPROCESSOR on the FILM REGISTRATION BOARD.

1. The MCS sends a “Film Coming” command to the FILM REGISTRATION BOARD. This command includes:
   - Film size
   - Film DRAWER
2. The leading edge of film is transported from the PICKUP and enters the FILM REGISTRATION AY.
3. The leading edge of film contacts the LEFT FILM GUIDE and moves down into the top pair of DRIVE ROLLERS.
4. The TRANSPORT MOTOR runs at full speed in the down direction.
5. The ROLLER ACTUATOR MOTOR closes the top 3 NIP ROLLERS.
6. The TRANSPORT MOTOR runs in the down direction until film is clear of the PICKUP.
7. The TRANSPORT MOTOR stops with the film in the ACCUMULATOR.
8. The TRANSPORT MOTOR runs at full speed in up direction.
9. The ACTUATOR MOTOR opens the 3 NIP ROLLERS.
10. The TRANSPORT ROLLERS run at low speed.
11. The CENTERING MOTOR moves the CENTERING FINGERS in to center the film.
12. The TRANSPORT MOTOR stops and the NIP ROLLERS close.
13. The application reports “Centering” completed to the MCS.
14. The MCS sends a “Transport” command to the FILM REGISTRATION BOARD.
15. TRANSPORT MOTOR runs until the leading edge of film is in the EXPOSURE TRANSPORT ROLLER.
16. ACTUATOR MOTOR opens the NIP ROLLERS.
17. TRANSPORT MOTOR stops.

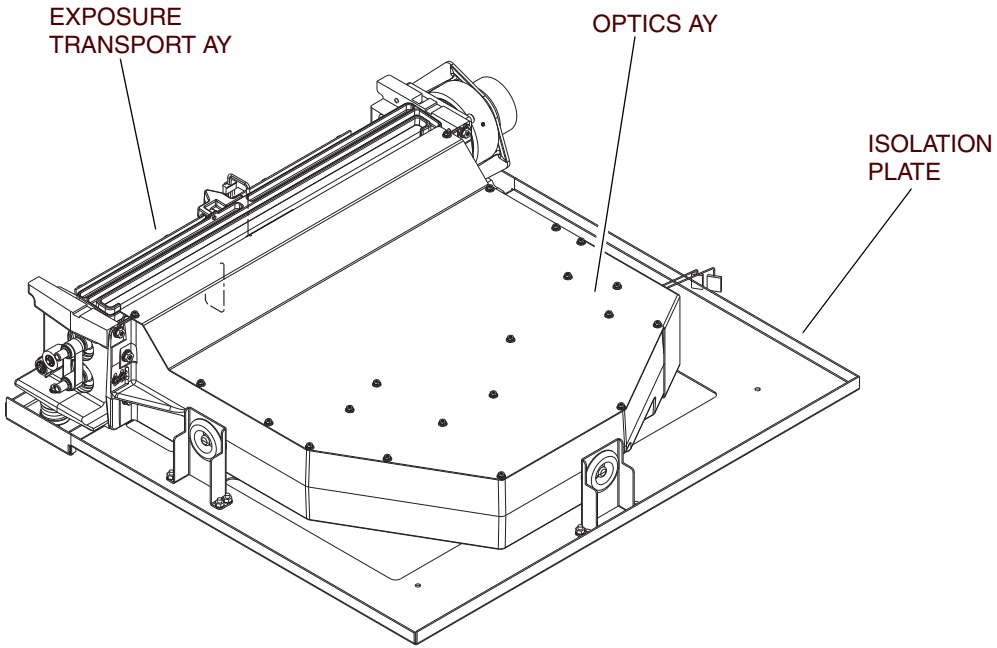
18. The application notifies the MCS that “Transport” is completed.

Film registration is complete. Film motion is now controlled by the EXPOSURE TRANSPORT.

Section 8: OPTICS/EXPOSURE TRANSPORT ASSEMBLY

The OPTICS/EXPOSURE TRANSPORT ASSEMBLY has 3 main parts, the OPTICS AY, the EXPOSURE TRANSPORT AY and the ISOLATION MOUNT.

Figure 11



- The OPTICS AY produces a scanning laser beam that exposes 1 line on the film. Each scan is one line of an image. See OPTICS AY on **Page 41**.
- The EXPOSURE TRANSPORT moves the film past the scanning line to expose an image. See EXPOSURE TRANSPORT AY on **Page 50**.
- The main purpose of the ISOLATION MOUNT is to prevent image artifacts caused by external vibration or vibration produced within the IMAGER. See ISOLATION MOUNT on **Page 58**.

Section 9: OPTICS ASSEMBLY

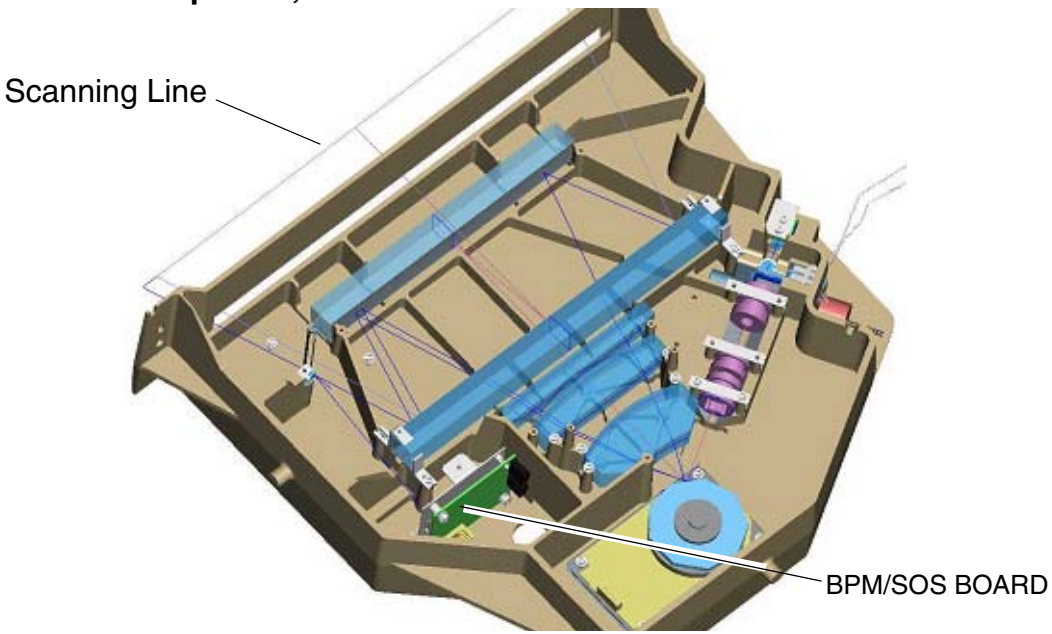
The OPTICS AY receives digital image data from the DRE, converts this data to a scanning laser beam that exposes film “line-by-line” when it is moved past the scanning line. Unlike other DryView IMAGERS, the scanning is one-dimensional. The laser beam moves left to right but does not move up or down. The film is moved past the scanning line by the EXPOSURE TRANSPORT to expose a page.

None of the components in the OPTICS AY are field replaceable. If a malfunction occurs in either the OPTICS or ELECTRONICS, the OPTICS AY is replaced.

Internal Configuration

The OPTICS AY has both OPTICAL COMPONENTS and CIRCUIT BOARDS. The following figure shows the OPTICAL COMPONENTS and 1 of the 3 CIRCUIT BOARDS in the OPTICS AY. The other BOARDS, the DATAPATH BOARD and LASER DRIVER BOARD are on the bottom of the AY, protected by a COVER.

Figure 12 **OPTICS AY - Top View, Cover Removed**



OPTICAL COMPONENTS

Figure 13 shows the LENSES, MIRRORS and other OPTICAL COMPONENTS in the OPTICS AY. The only moving parts are the POLYGON MIRROR, the SPINNER MOTOR (not shown), the ATTENUATOR FILTER, and the ATTENUATOR MOTOR (not shown).

Figure 13

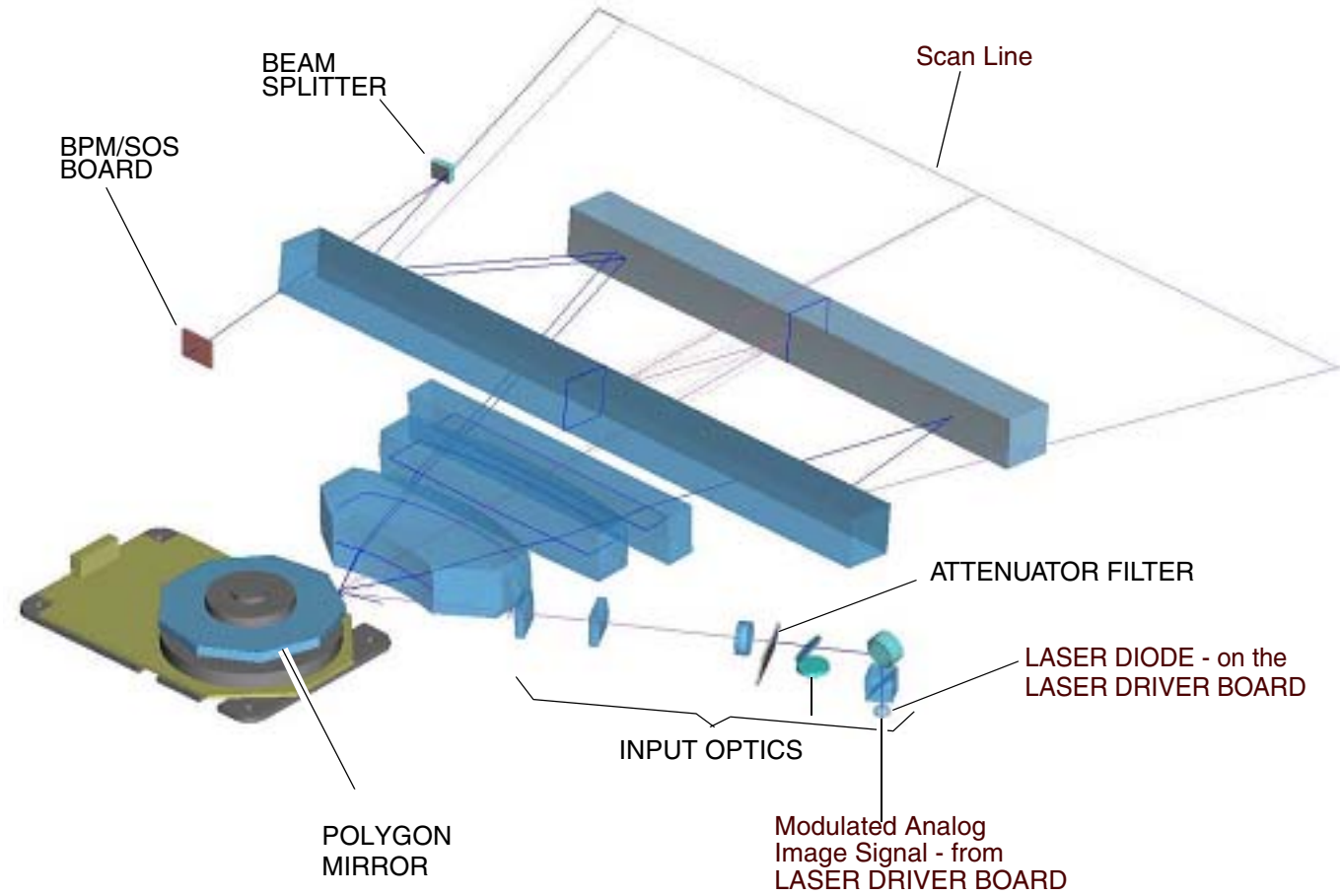


Figure 14 shows another view of scanning LENSES and MIRRORS.

Figure 14

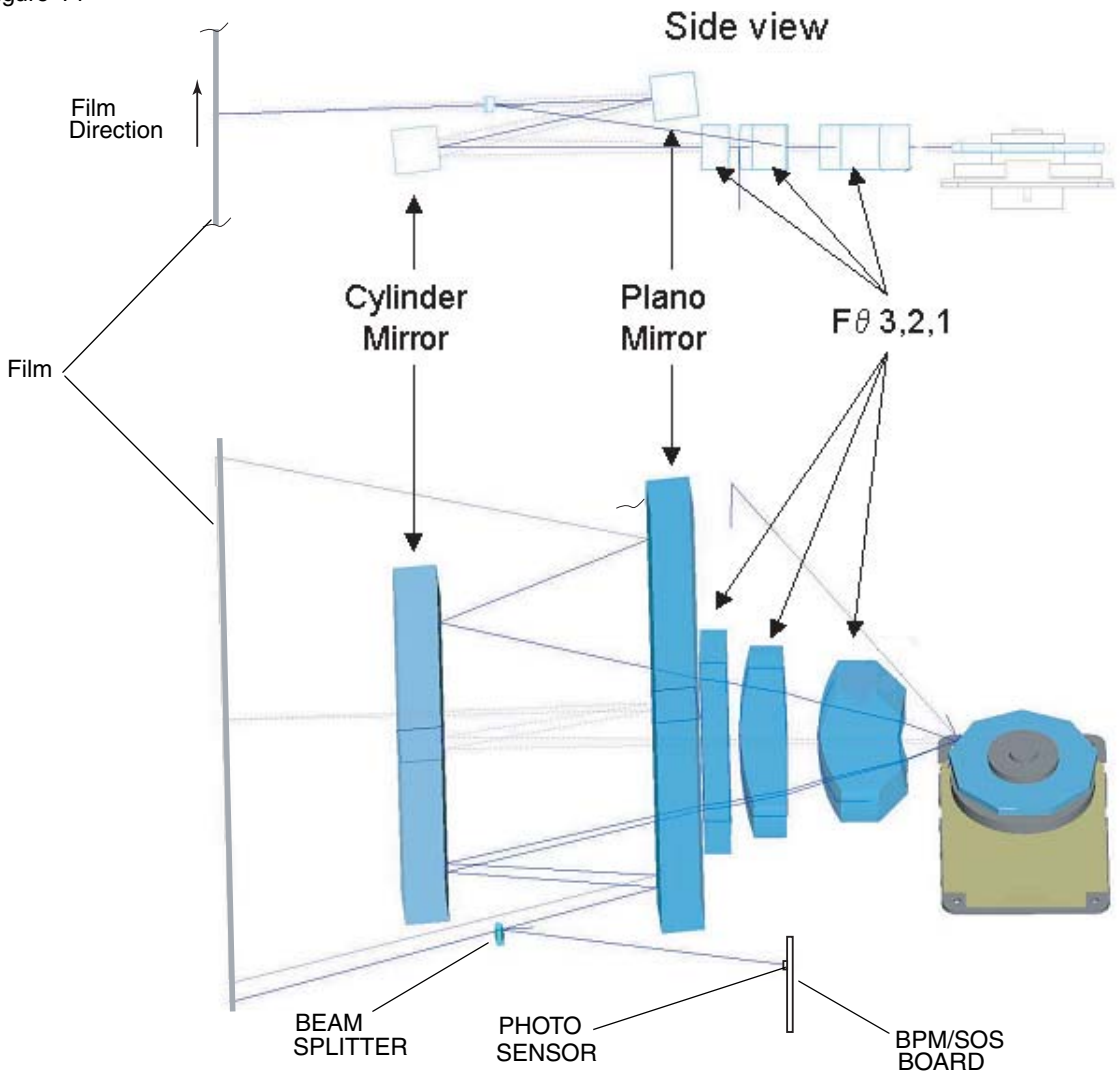
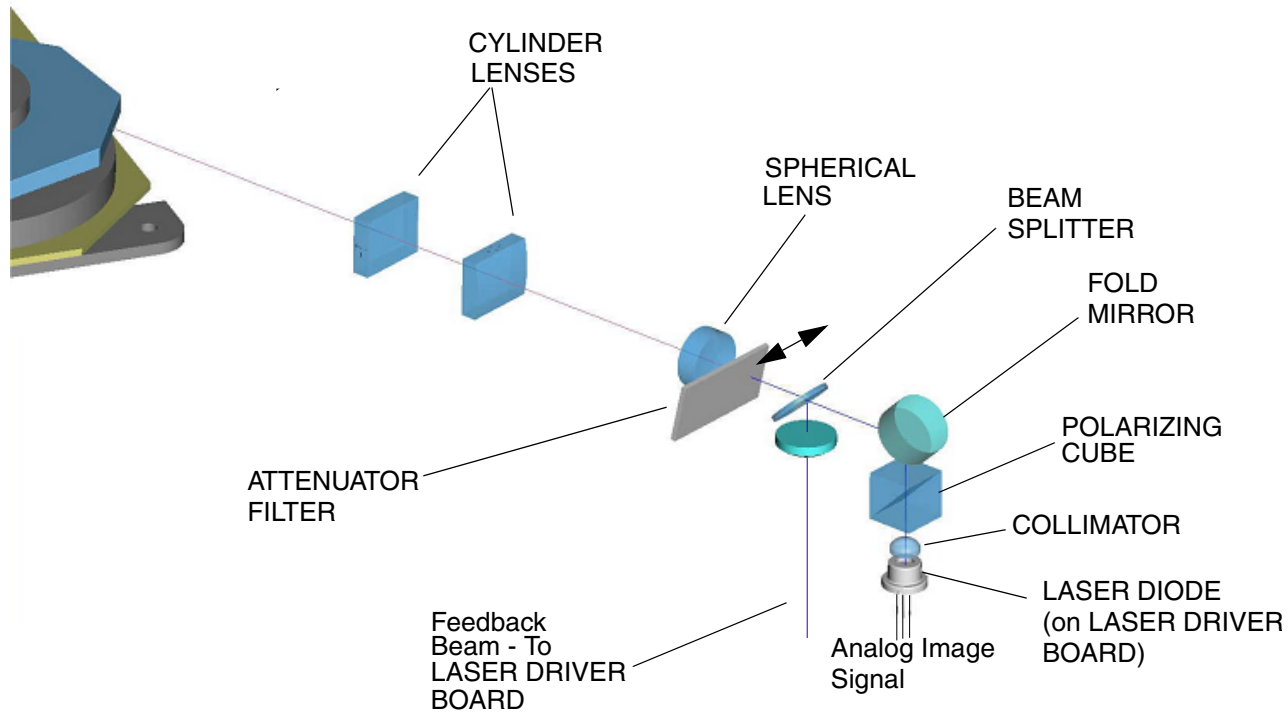

Side view
Film
Direction
Film
Cylinder
Mirror
Plano
Mirror
Fθ 3,2,1
BEAM
SPLITTER
PHOTO
SENSOR
BPM/SOS
BOARD

Figure **15** shows the INPUT OPTICS that generates and shapes the laser beam.

Figure 15 **Input OPTICS**



The LASER DIODE, located on the LASER DRIVER BOARD, emits a beam of light. The COLLIMATOR converts the beam to a “more-nearly” parallel beam.

The image signal that drives the LASER DIODE is an analog version of the pixel stream that represents 1 line of the image. This input signal changes the power of the laser beam when it scans across the film.

A small fraction of the laser beam is sent back to a PHOTO SENSOR on the LASER DRIVER BOARD by the BEAM SPLITTER. This feedback is used to “stabilize” the laser drive circuits.

The ATTENUATOR is a “variable-density” FILTER that is moved in the laser beam path to change the power of the laser beam. An ATTENUATOR MOTOR and DRIVE MECHANISM, controlled by the BEAM POWER MONITOR (BPM) BOARD, moves the ATTENUATOR. An ATTENUATOR HOME SENSOR that connects to the BPM BOARD indicates when the ATTENUATOR is positioned at the home position.

OPTICS AY ELECTRONICS

The OPTICS ELECTRONICS has 4 CIRCUIT BOARDS.

- DATA PATH BOARD (DPB)
- LASER DRIVER BOARD
- BEAM POWER MONITOR/ START OF SCAN BOARD (BPM\SOS BOARD)
- START OF PAGE BOARD (SOP BOARD)

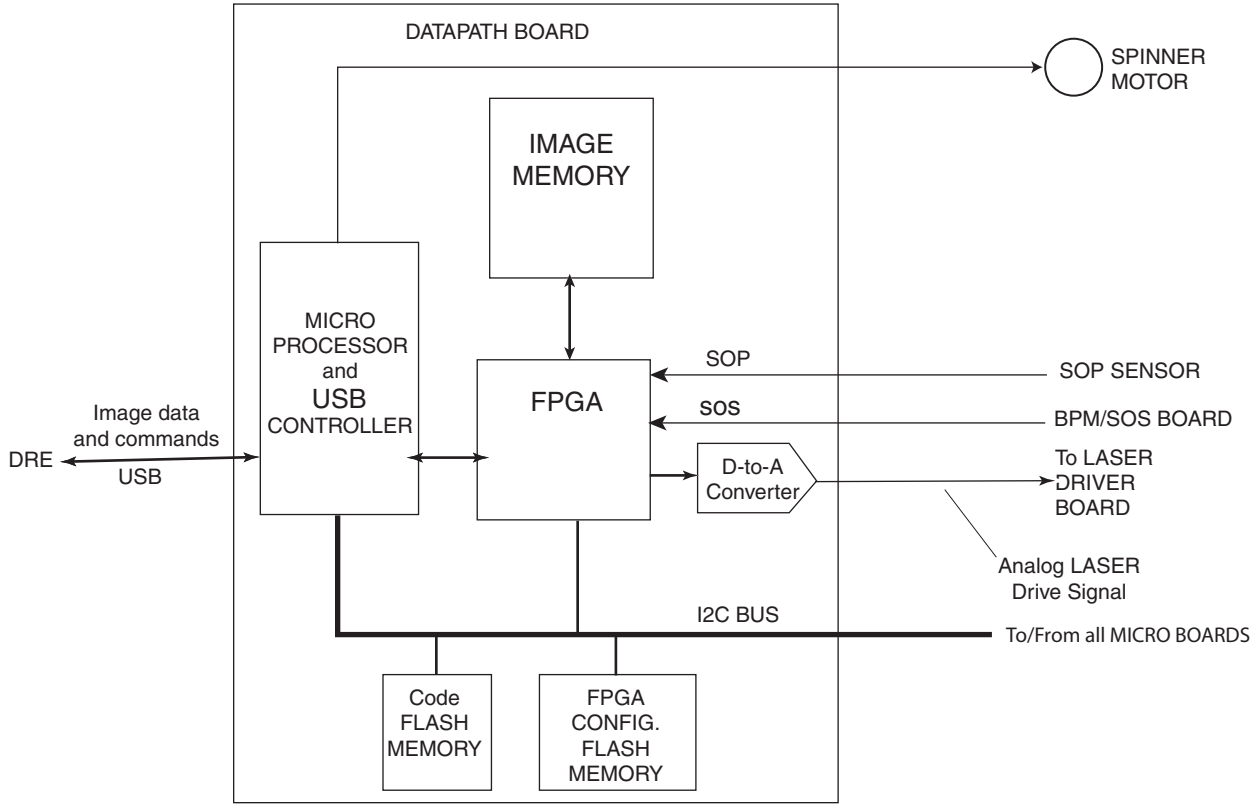
The first 3 BOARDS are in the OPTICS AY. The SOP BOARD is located in the EXPOSURE TRANSPORT and, unlike the other 3 BOARDS, can be replaced in the field.

DATAPATH BOARD - This BOARD has 3 main functions:

- It provides the path for image data from the DRE to the OPTICS AY.
- It connects the DRE to the I2C bus that is shared by all of the MICRO BOARDS.
- It drives the SPINNER MOTOR for the POLYGON MIRROR in the OPTICS AY.

Figure 16 is a simplified block diagram of the DATAPATH BOARD.

Figure 16



The DATAPATH BOARD connects to the USB port on the DRE. The DRE sends both image data and commands across the USB interface. A CONTROLLER on the BOARD does a translation between the USB protocol and the I2C protocol. The DRE sends commands to the MICRO BOARDS on the USB /I2C path and the MICRO BOARDS return status information to the DRE on this path.

The DATAPATH BOARD has MEMORY for 1 image. When the DRE sends an image, it is placed in the image MEMORY. Each line of the image is then read from MEMORY. A DIGITAL-TO-ANALOG CONVERTER changes each pixel to an analog voltage value. This changing voltage controls the power of the LASER when the beam scans across the film.

The FPGA (“Field Programmable Gate Array”) is a complex circuit chip that is programmed to write an image into the IMAGE MEMORY and then read it during the “imaging” process.

SOP (START OF PAGE) BOARD - This BOARD has a PHOTOSENSOR and an AMPLIFIER. It provides a film position indication when the leading edge of the film crosses the scanning laser beam. When the film blocks the beam from reaching the PHOTOSENSOR, the SOP BOARD sends a signal to the DATAPATH BOARD to start exposure of the film.

BPM/SOS (BEAM POWER MONITOR/START OF SCAN) BOARD - This BOARD has 4 functions:

- It detects when the laser beam is at the beginning of the scan and sends a start-of-scan pulse to the DATAPATH BOARD.
- It samples the power level of the laser beam and sends a power level reading to the MCS when asked for.
- It controls the laser beam ATTENUATOR MECHANISM based on commands from the MCS.
- It measures the laser beam drive voltage and reports the value to the MCS when asked for.

This BOARD has a PHOTOSENSOR that is positioned at the start of the laser beam scan path. This SENSOR detects the start of a scan and is also used to measure the power level of the laser beam. The BOARD connects to the ATTENUATOR MOTOR and the ATTENUATOR HOME POSITION SENSOR. It has a MICROPROCESSOR that communicates with the MCS on the I2C BUS and runs the application software that controls the functions of the BOARD.

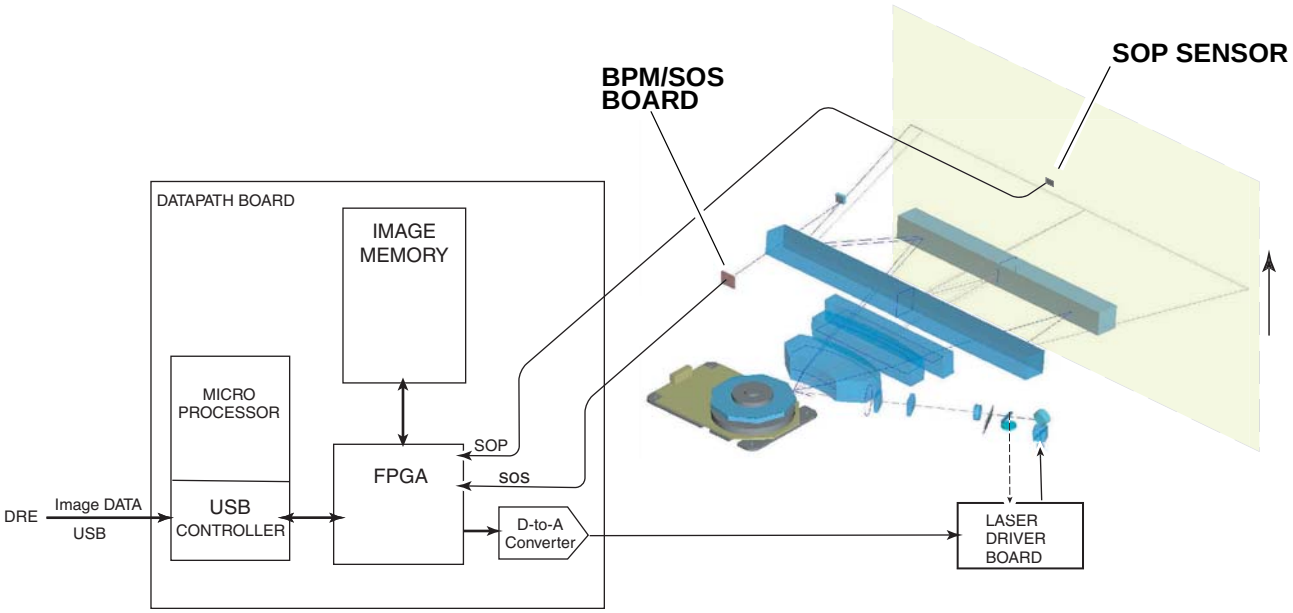
LASER DRIVER BOARD - This BOARD has the LASER DIODE that emits the laser beam used to expose film. It has electrical circuits to drive the LASER DIODE and a PHOTOSENSOR that receives a feedback beam “split off” from the main laser beam. The feedback is used to “stabilize” the laser drive circuits. This BOARD receives DC power and image data from the DATAPATH BOARD. For each line in the image, the DATAPATH BOARD sends an analog laser drive signal that represents the image.

“Imaging” Process

In the “imaging” process the OPTICS assembly converts a digital image to an image on film. Figure 17 shows the main ELECTRONICS and OPTICAL COMPONENTS in this process.

The digital image sent by the DRE is a collection of 14-bit pixel values that is organized into image lines. Each line in the digital image is 1 scan line on film.

Figure 17



Before the “imaging” process begins:

- The POLYGON MIRROR is “spinning”.
- The LASER generates a beam that reaches the SOP SENSOR on each scan.
- The MCS has started the steps to pick up and transport a film to the IMAGING ASSEMBLY. The EXPOSURE TRANSPORT will move the film past the scanning line at the proper rate.

The steps in the “imaging” process are:

1. The DRE does 3 tasks at the same time:

   - Sends data for 1 image across the USB channel.

   - Samples the BEAM POWER MONITOR and sets the ATTENUATOR.

   - Loads parameters in the FPGA (example, the number of lines and pixels in the image).

2. The USB CONTROLLER moves the image data on to the IMAGE MEMORY through the FPGA.
3. When the leading edge of film interrupts the laser beam, the START-OF-PAGE SENSOR sends a signal to the FPGA.
4. The FPGA starts reading lines of data from the IMAGE MEMORY.
5. When the BPM/SOS BOARD detects the start of a scan, it sends a SOS pulse to the FPGA.
6. When it receives a SOS pulse, the FPGA starts to send a line of pixels in a serial bit stream to the “D-to-A” CONVERTER.
7. When the laser beam scans across the film, the “D-to-A” CONVERTER converts the stream of pixels to an analog signal that represents the image line.
8. During the scan, the analog signal drives the LASER DIODE on the LASER DRIVER BOARD. The power of the laser beam changes when the “amplitude” of the analog signal changes.
9. Each time the FPGA detects an SOS pulse, the “D-to-A” conversion process repeats for the next line of data.

Section 10: EXPOSURE TRANSPORT AY

Function

The function of the EXPOSURE TRANSPORT AY is to move a sheet of film past the laser scan line at a constant velocity and at a precise fixed distance from the MIRROR.

- Film velocity is 29.185 mm/sec (1.15 in./sec).
- Focal distance is 210 mm (8.26 in.) at the scan center.

Figure 18

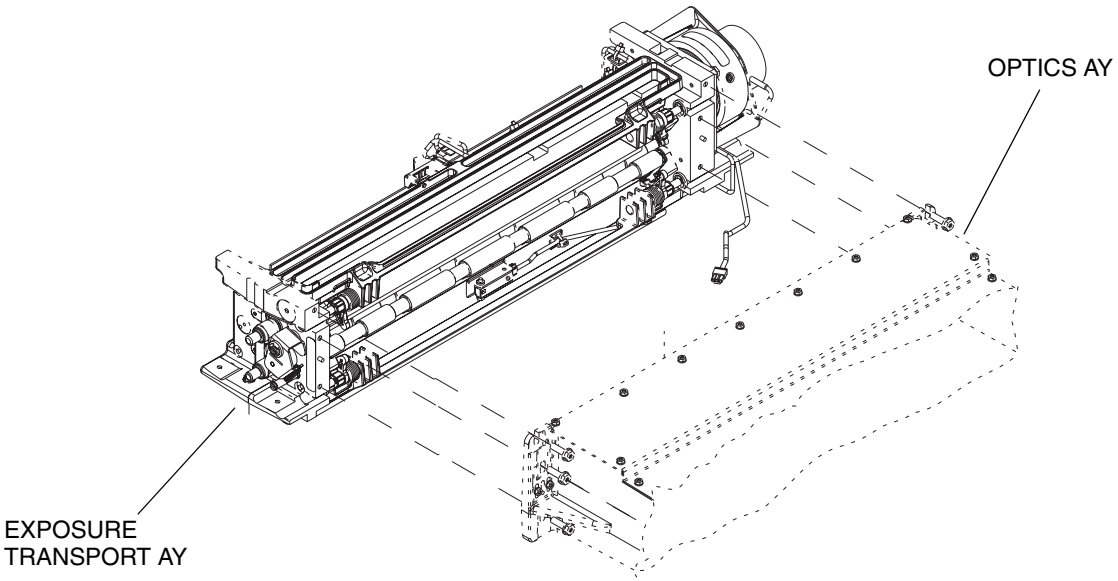


Figure 19 is a larger view of the EXPOSURE TRANSPORT.

Figure 19

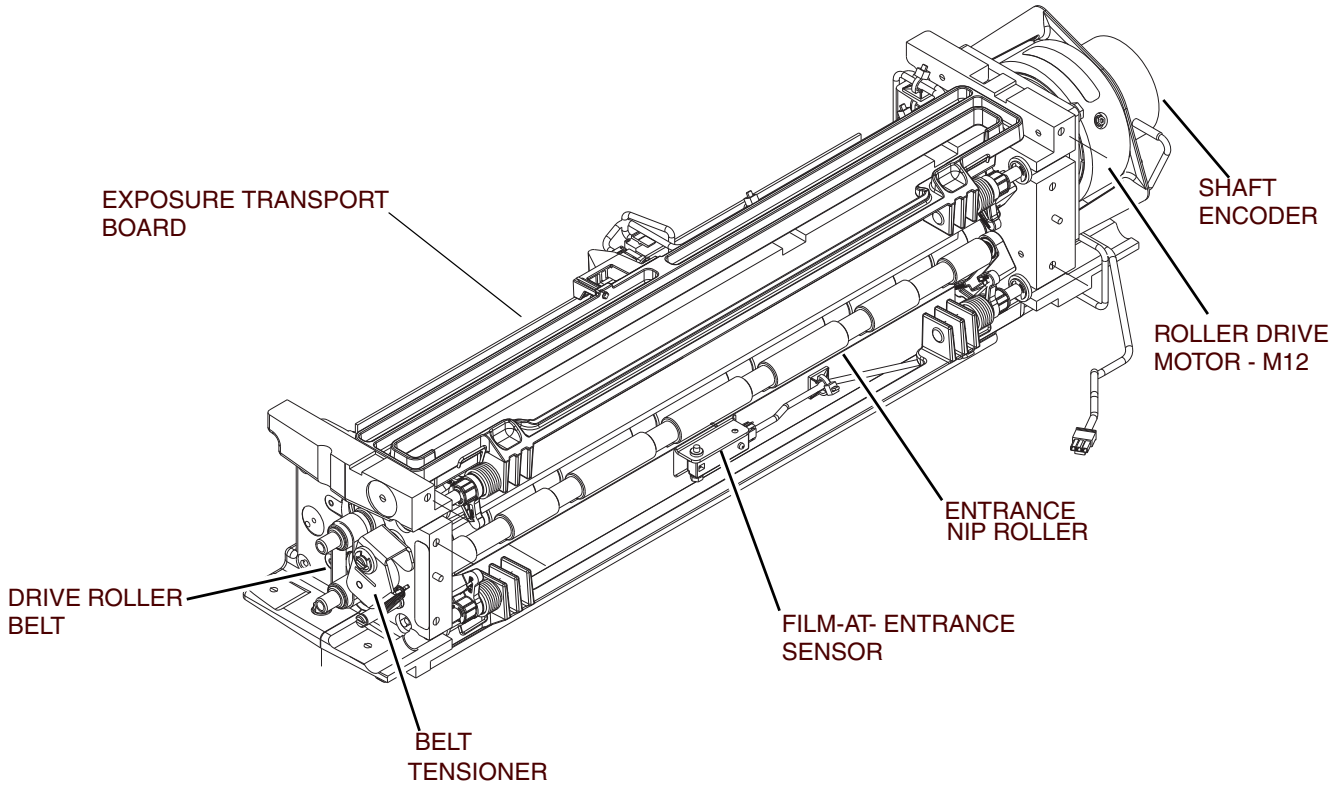
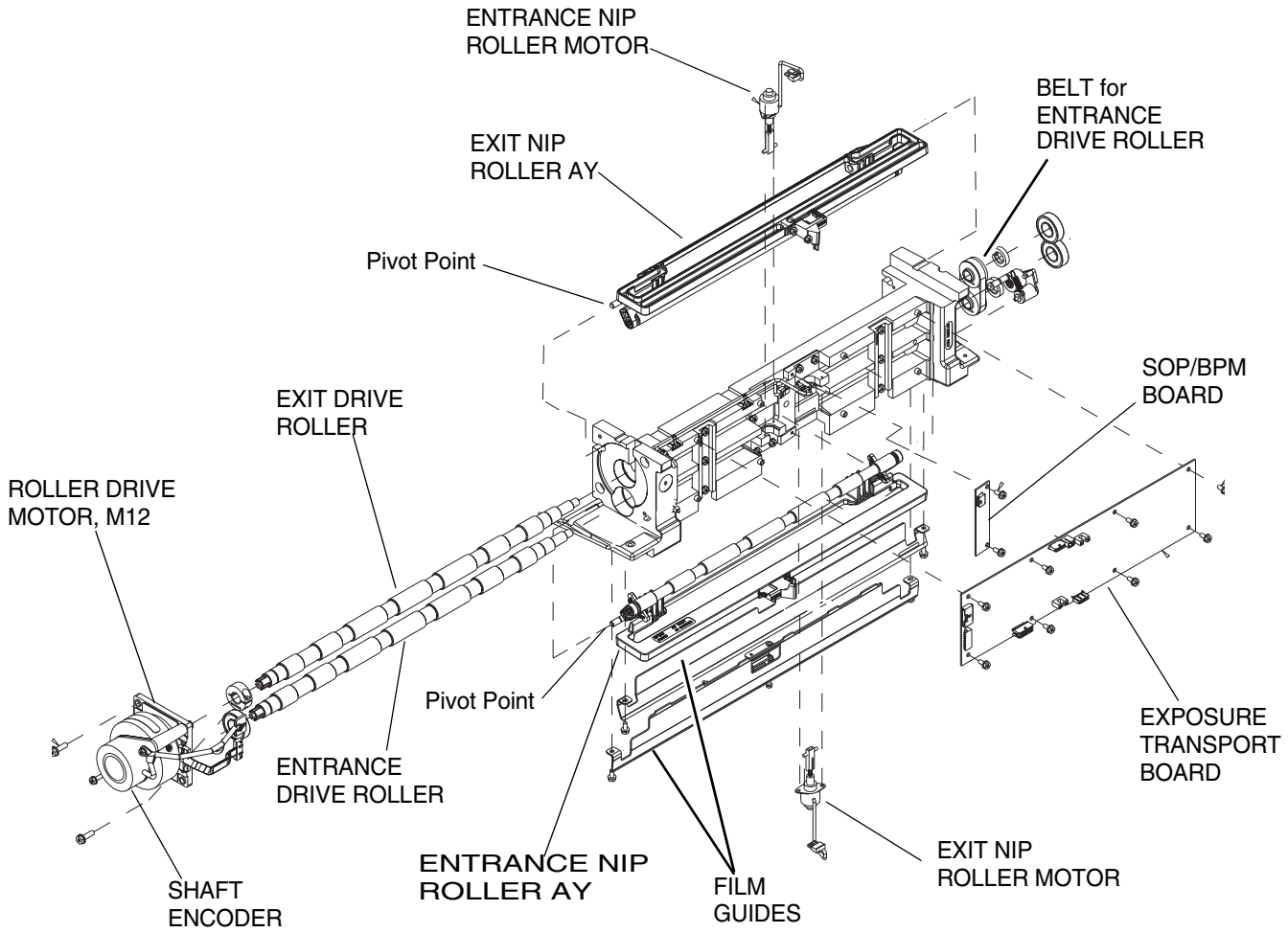


Figure 20 shows the main parts in the EXPOSURE TRANSPORT.

Figure 20

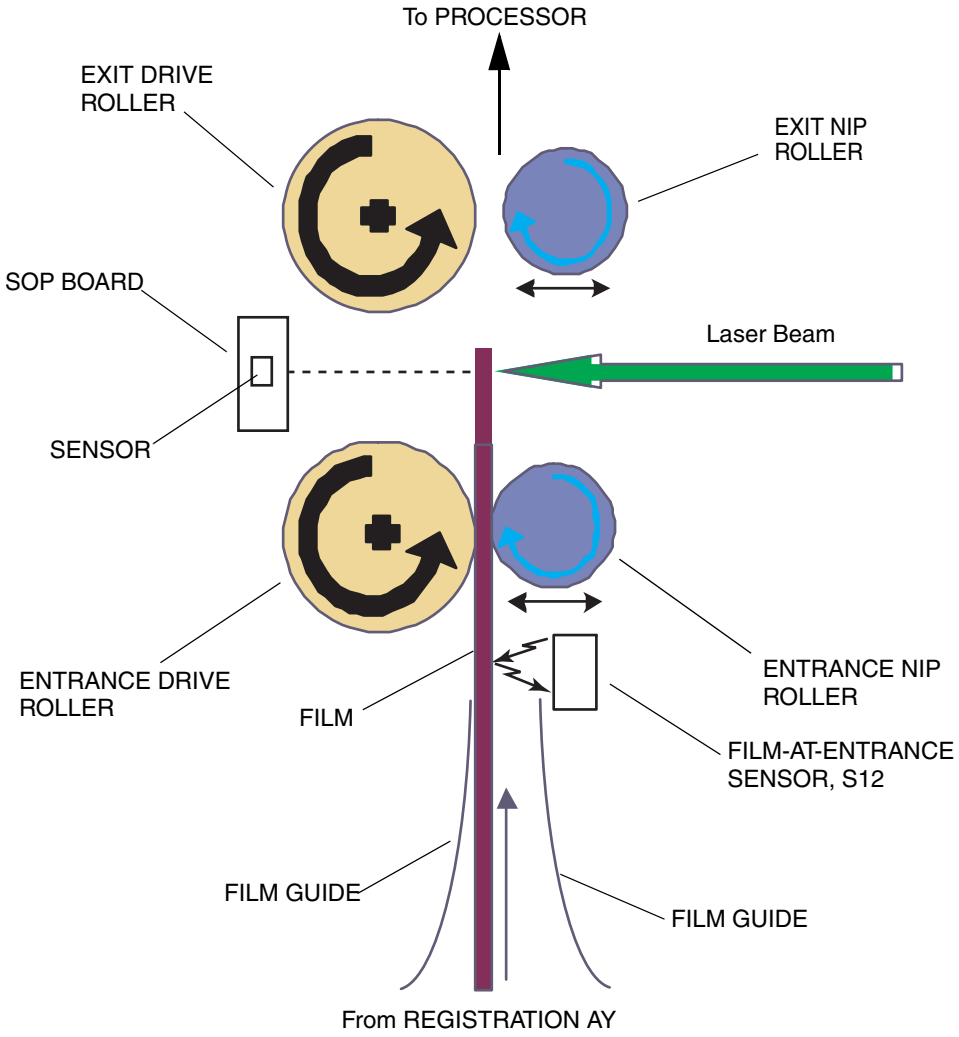


How It Works

Figure 21 is a simplified view of the ROLLERS that move film through the EXPOSURE TRANSPORT. The 2 DRIVE ROLLERS are operated by the ROLLER DRIVE MOTOR, M12. The MOTOR connects directly to the shaft of the EXIT DRIVE ROLLER. The ENTRANCE DRIVE ROLLER is operated by a BELT and PULLEY from the EXIT DRIVE ROLLER.

Each DRIVE ROLLER has a companion NIP ROLLER that is opened and closed by a LINEAR STEPPER MOTOR. Film is moved upward when a NIP ROLLER closes and holds film against the adjacent DRIVE ROLLER. The speed of the SERVO MOTOR and opening and closing of the 2 NIP ROLLERS is controlled by software on the EXPOSURE TRANSPORT BOARD.

Figure 21



The following sequence occurs when a film is moved through the EXPOSURE TRANSPORT.

1. Before film arrives, the NIP ROLLERS are pre-set:
   - The ENTRANCE NIP ROLLER is moved to the closed position.
   - The EXIT NIP ROLLER is moved to a partially closed position.
2. Film is moved up to the EXPOSURE TRANSPORT by the REGISTRATION AY.
3. Film leading edge “passes” the FILM-AT-ENTRANCE SENSOR, S12. This starts a software timer.
4. Film enters the ENTRANCE ROLLERS.
5. NIP ROLLERS in the REGISTRATION AY open after FILM-AT-ENTRANCE signal. Film motion is now controlled by the EXPOSURE TRANSPORT.
6. The ENTRANCE ROLLERS drive the film upward.
7. Film leading edge blocks the laser beam at the SOP SENSOR, S13.

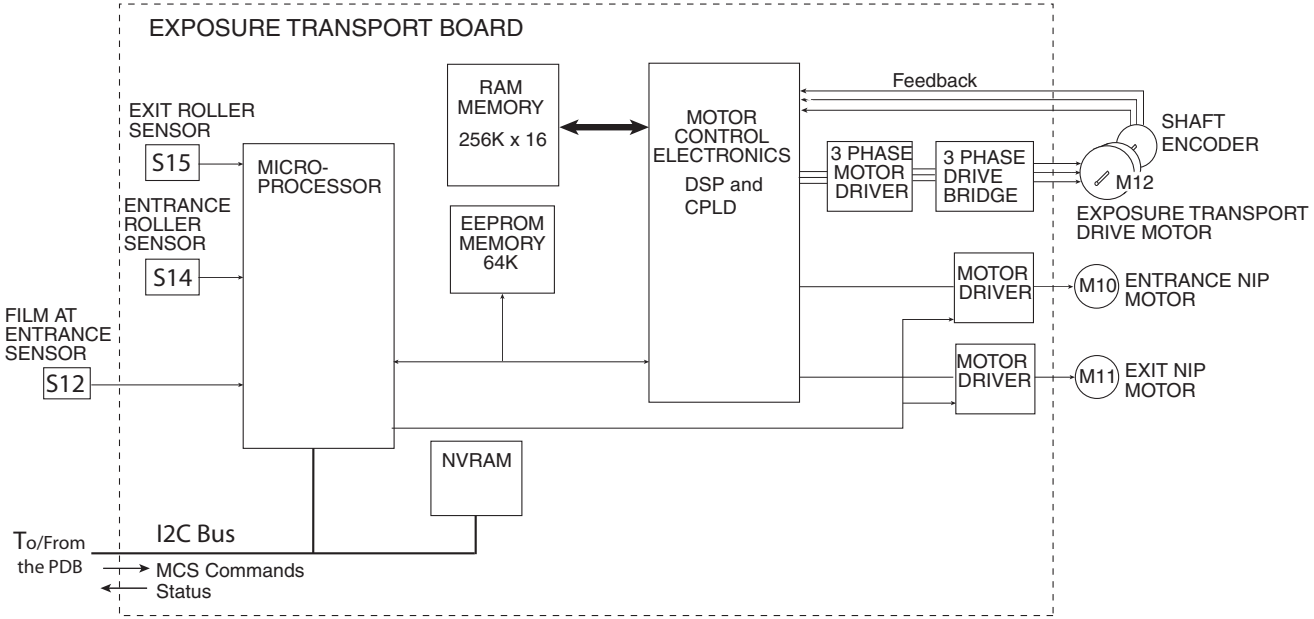
   The SOP signal does not affect the EXPOSURE TRANSPORT but it does start the exposure process when film is in the EXPOSURE TRANSPORT.
8. The scanning laser beam starts to expose the film.
9. The EXIT NIP ROLLER starts to close - 1.25 seconds after film reaches the FILM-AT-ENTRANCE SENSOR.
10. The ENTRANCE NIP ROLLER starts to open partly - 1.75 seconds after film reaches the FILM-AT-ENTRANCE SENSOR.
11. The EXIT ROLLERS drive film for the remainder of the exposure.
12. Film enters the PROCESSOR.

    Film development begins as exposure continues in the EXPOSURE TRANSPORT.
13. Film trailing edge “passes” the FILM-AT-ENTRANCE SENSOR, S12. This starts a software timer.
14. The EXIT NIP starts to open - 3.0 seconds after the trailing edge “passes” the FILM-AT-ENTRANCE SENSOR, S12
15. ENTRANCE and EXIT NIP ROLLERS are moved “home” (full-open) and then pre-set in preparation for the next film.

EXPOSURE TRANSPORT CONTROL SYSTEM

The EXPOSURE TRANSPORT BOARD (ETB) controls the functions of the EXPOSURE TRANSPORT. Figure 24 shows how the ETB connects to the external components it controls.

Figure 22



ETB - The ETB controls the speed of the EXPOSURE TRANSPORT DRIVE MOTOR, M12 and also controls the 2 linear STEPPER MOTORS, M10 and M11, that open and close the ENTRANCE and EXIT NIP ROLLERS. Application software that runs in the MICROPROCESSOR and in the DSP (DIGITAL SIGNAL PROCESSOR) provides the control intelligence.

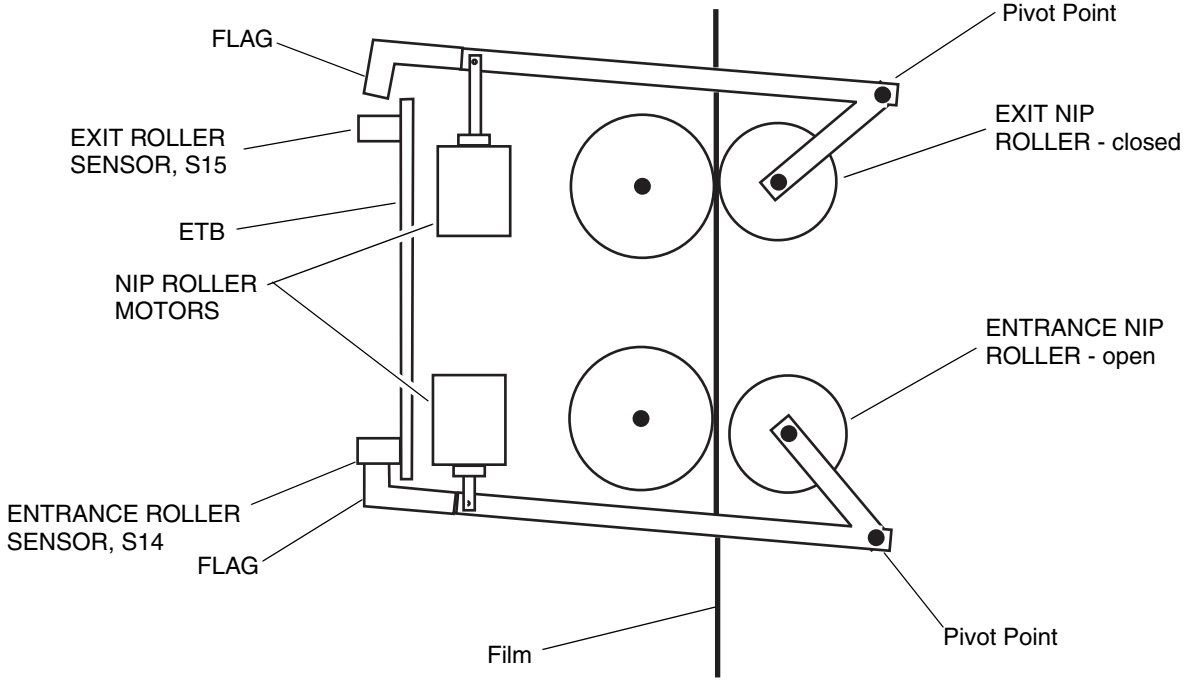
The MOTOR CONTROL ELECTRONICS has 2 complex microcircuits: a DSP and a CPLD (COMPLEX PROGRAMMABLE LOGIC DEVICE). The DSP has a MICROPROCESSOR and runs a part of the application software.

There are “testpoints” and LEDs on the ETB. Some of these are useful for trouble shooting. See the FUNCTIONAL BLOCK DIAGRAMS for a description of the test points and LEDs.

EXPOSURE TRANSPORT DRIVE MOTOR and SHAFT ENCODER - This 3-phase SERVO MOTOR is “powered” by a 3-phase AC voltage generated by the MOTOR CONTROL ELECTRONICS. MOTOR speed is controlled by controlling the frequency of the AC MOTOR voltage. When the MOTOR turns, the SHAFT ENCODER, mounted on the MOTOR SHAFT, provides a stream of pulses, 2000 pulses per revolution. Feedback from the SHAFT ENCODER is used in a closed loop control system to monitor and control the speed of the SERVO MOTOR.

NIP ROLLER MOTORS - These 2 MOTORS are linear STEPPER MOTORS that open and close the NIP ROLLERS. These MOTORS can move the NIP ROLLERS to the fully opened “Home” position, the fully closed position or any position in between. Figure 23 shows a simplified diagram of the mechanism that opens and closes the NIP ROLLERS

Figure 23 **NIP ROLLER MECHANISM**



FILM AT ENTRANCE SENSOR, S12 - This reflective SENSOR is located on the film guide at the entrance to the EXPOSURE TRANSPORT BOARD. The SENSOR emits a light beam and also has a detector to sense reflected light. The output of the SENSOR is high when no light

is reflected back. When film enters the light path, light is reflected back to the SENSOR causing the output to “go” low. The application software on the ETB uses the output of this SENSOR to time the opening and closing of the NIP ROLLERS.

ENTRANCE ROLLER SENSOR, S14 - This SENSOR indicates when the ENTRANCE NIP ROLLER is at the full open position. The SENSOR BODY is mounted on the ETB. When the ENTRANCE NIP ROLLER is fully open. a flag on the NIP ROLLER mechanism blocks the light beam in the SENSOR BODY, causing the output to change state.

EXIT ROLLER SENSOR, S15 - This SENSOR indicates when the EXIT NIP ROLLER is at the full open position. The SENSOR BODY is located on the ETB and operates identically to the ENTRANCE ROLLER SENSOR.

Section 11: ISOLATION PLATE

To Be Supplied

Section 12: THERMAL PROCESSOR

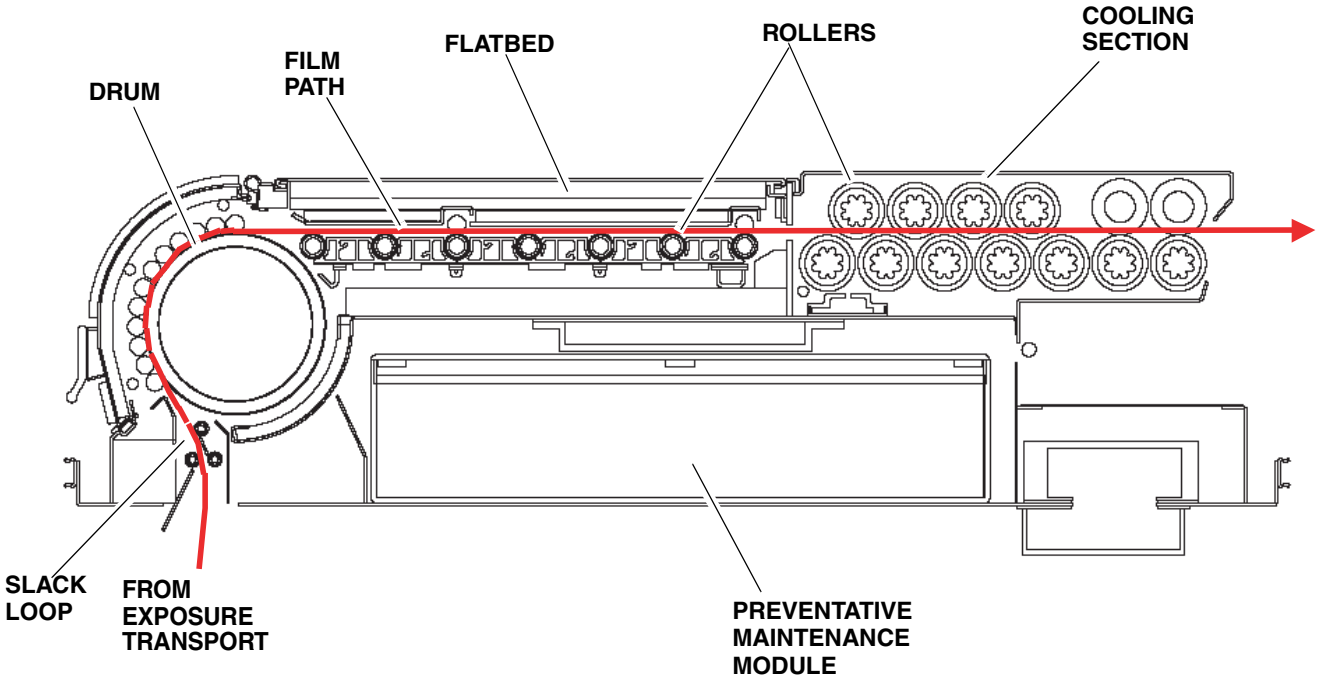
Purpose

The purpose of the PROCESSOR is to:

- Develop the film image.
- Collect vapors (out-gasses) released when the film is heated.

This PROCESSOR is different from the PROCESSORS in all other *DryView* IMAGERS. In this PROCESSOR film is developed in 2 stages. The DRUM first rapidly heats the film to processing temperature. The film then moves into the heated FLATBED AREA to complete the process. Most vapors are released after the film is transported from the DRUM, which accounts for less FAZ on the DRUM than in other *DryView* IMAGERS.

Figure 24 **PROCESSOR - Side View**



Because film remains on the DRUM only to “pre-heat”, the DRUM moves faster than in other *DryView* IMAGERS.

The PROCESSOR is on a DRAWER that pulls out. Using the SERVICE SWITCH, service technicians can operate the PROCESSOR when it is extended.

Main Components

- SLACKLOOP AY- A set of 3 ROLLERS at the entrance to the PROCESSOR that make a loop in the film to prevent tension in the film between the PROCESSOR and the EXPOSURE TRANSPORT. The purpose is to prevent the film from sending vibration from the DRUM back to the EXPOSURE TRANSPORT.
- DRUM - Heats the film rapidly to processing temperature, 129° C $\pm$ 0.1° C.
- FLATBED - Keeps processing temperature, about 1° C less than the temperature of the DRUM, to develop the image.
- COOLING SECTION - Removes heat from the film to stop image development and harden the base.
- PREVENTIVE MAINTENANCE MODULE (PMM)- Captures and condenses vapors released from the film when heated.
- PROCESSOR CONTROL BOARD (PCB) - This CIRCUIT BOARD has 2 MICROPROCESSORS and other ELECTRONICS that control HEATERS, FANS and transport MOTORS in the PROCESSOR. Temperature “setpoints” and other parameters are stored in NVRAM.
- PROCESSOR application software - Runs in the 2 MICROPROCESSORS on the PCB to control HEATERS, cooling FANS and the 2 transport MOTORS in the PROCESSOR.

Transport Within the PROCESSOR

Film is moved through the PROCESSOR by the rotating DRUM and ROLLERS in the FLATBED and COOLING SECTION. A 24 V DC STEPPER MOTOR operates the DRUM. A second 24 V DC STEPPER MOTOR operates the ROLLERS in the FLATBED and COOLING SECTION. Both MOTORS connect to MOTOR DRIVERS on the PCB. The speed of both MOTORS is controlled by the PROCESSOR

CONTROL BOARD based on speed “setpoints” in NVRAM. Transport time through the PROCESSOR is 22.5 seconds which is a throughput of 160 films per hour.

SLACKLOOP AY

The SLACKLOOP AY is a set of 3 ROLLERS before the entrance to the DRUM that make a slight loop in the film. The loop is a “shock absorber” between the EXPOSURE TRANSPORT and the PROCESSOR. It isolates the EXPOSURE TRANSPORT from impact when the leading edge of the film contacts the DRUM and it prevents the film from sending vibration from the PROCESSOR back to the EXPOSURE TRANSPORT. The SLACKLOOP AY has no MOTORS or ACTUATORS.

DRUM

The DRUM HAS 3 heat zones. Each zone includes a 120 V AC HEATER and a RTD TEMPERATURE SENSOR. SLIP RINGS on the SHAFT of the DRUM provide electrical connections to the PCB.

To control temperature of the DRUM, the PROCESSOR application software scans the RTD SENSORS and switches 120 V AC power to the 3 HEATERS ON and OFF to keep the temperature “setpoints” in NVRAM.

A DRIVE TRAIN sends power from the DRUM MOTOR to the DRUM.

A DRUM COVER provides access for cleaning the DRUM and clearing film jams.

FLATBED

The FLATBED is a covered area with HEATERS above and below the film path. There are 8 heat zones with 8 RTD TEMPERATURE SENSORS. In the FLATBED BASE below the film there are 9 HEATERS and 6 RTDs. Above the film, in the FLATBED COVER, there are 2 HEATERS and 2 RTDs. For “over-temperature” protection there are 3 THERMAL CUTOFF DEVICES in the FLATBED BASE and 2 in the COVER.

The PROCESSOR application software scans the RTD SENSORS and switches 120 V AC power to the 8 heat zones ON and OFF to keep processing temperature. If a high temperature malfunction occurs, one of the THERMAL

CUTOFFS in the FLATBED opens. This interrupts 120 V AC power to all HEATERS in the FLATBED and DRUM.

COOLING SECTION

Film is cooled by contact with “hollow” ROLLERS in the COOLING SECTION. The TEMPERATURE MICROPROCESSOR controls 2 FANS that blow cooling air through the “hollow” ROLLERS to remove the heat. Temperature is controlled by changing the speed of the 2 FANS.

PROCESSOR CONTROL BOARD

The PROCESSOR CONTROL BOARD (PCB) provides:

- Power and temperature control for the 3 HEATER zones on the DRUM.
- Power and temperature control for the 6 HEATER zones in the FLATBED PLATE.
- Power and temperature control for the 2 HEATER zones in the FLATBED COVER.
- Power and control for the 2 STEPPER MOTORS.
- Power and control for 2 COOLING FAN MOTORS.
- Power and control for 4 DC FAN MOTORS: the MAKEUP AIR FAN, the HEAT EXCHANGER FAN, and 2 FILTER FANS.
- Power for a DC FAN that runs to cool the PROCESSOR CONTROL BOARD.

The PCB has 2 MICROPROCESSORS. The TEMPERATURE MICROPROCESSOR controls the temperatures of the 11 heat zones and also controls 6 FANS in the PROCESSOR. The main application software runs in this MICROPROCESSOR. The software for the 2 TRANSPORT MOTORS is in the MOTOR MICROPROCESSOR. Both MICROPROCESSORS are connected to the I2C bus and to a shared NVRAM, also on the I2C bus. The MICROPROCESSORS communicate with each other on the I2C bus and through the shared NVRAM.

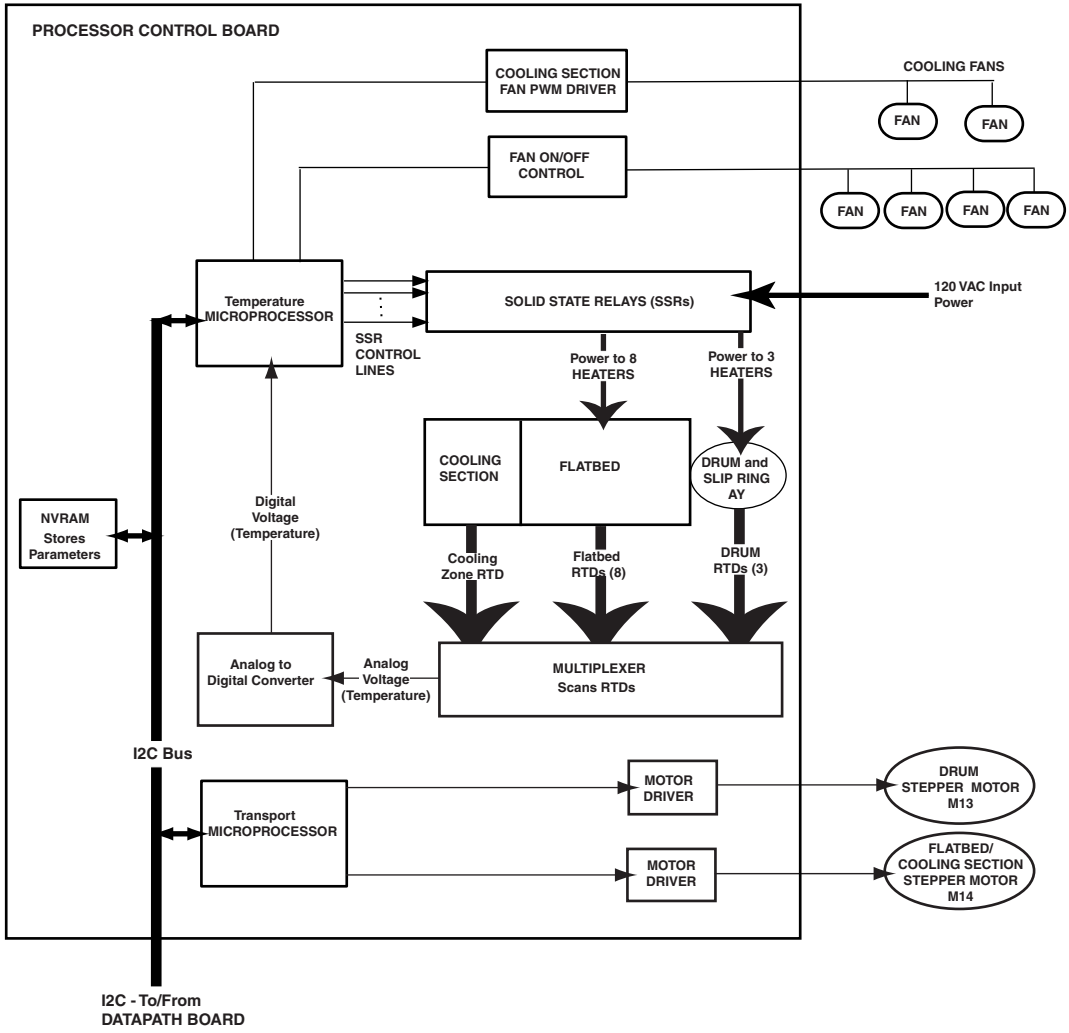
Each heat zone has a RESISTANCE TEMPERATURE DEVICE (RTD) and 1 or more HEATER ELEMENTS “bonded” to an “aluminum substrate”. The RTD senses

the temperature of the “aluminum base” by changing the electrical resistance. The resistance is measured by switching a “known” current through the RTD and measuring the voltage across it.

A MULTIPLEXER on the PCB connects the RTDs for the 11 heat zones to the MICROPROCESSOR. Through the MULTIPLEXER, the MICROPROCESSOR scans the RTD voltages. An ANALOG-TO-DIGITAL CONVERTER on the BOARD converts each analog voltage to a digital temperature value. The application software compares the temperature value for each zone with the temperature “setpoint” for that zone, stored in NVRAM. The application then switches the corresponding HEATERS ON or OFF in response to the differences between the measured temperatures and temperature “setpoints”. SOLID STATE RELAYS (SSRs) on the BOARD, controlled by the MICROPROCESSOR, switch 120 V AC current to the HEATERS.

An additional RTD at the entrance of the DRUM senses a decrease in temperature caused by heat transfer to the film during periods of high usage. In response, the application software adjusts temperature “setpoints” for the DRUM upward to offset for the heat loss.

Figure 25 **PROCESSOR CONTROL BOARD**



The TEMPERATURE MICROPROCESSOR controls the HEATERS and 6 of the 7 FANS in the COOLING SECTION. See **AIRFLOW in the PROCESSOR**.

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The second MICROPROCESSOR controls the 2 transport MOTORS in the PROCESSOR.

There are a number of LED INDICATORS on the BOARD that show the status of the THERMAL CUTOUTS, status of HEATERS and a number of other conditions. See the 6800 FUNCTIONAL DIAGRAMS for a description of the LEDs

AIRFLOW in the PROCESSOR

The graphic on Page 66 shows the 7 FANS that move air through the PROCESSOR. All of these FANS, except the CIRCUIT BOARD FAN, are controlled by the TEMPERATURE MICROPROCESSOR.

The 2 FILTER FANS and the MAKE-UP AIR FAN provide air flow through the DRUM and FLATBED areas to remove vapors released when film is heated. The vapors are condensed and collected in the PREVENTATIVE MAINTENANCE MODULE (PMM). The FILTER FANS also pull air that has a low level of processing vapors from the COOLING SECTION into the PMM. When the IMAGER is in “Standby” mode, the MICROPROCESSOR turns these FANS OFF.

The HEAT EXCHANGE FAN blows cooling air through a HEAT EXCHANGER in the PMM that cools the vapor stream. The vapor stream is cooled:

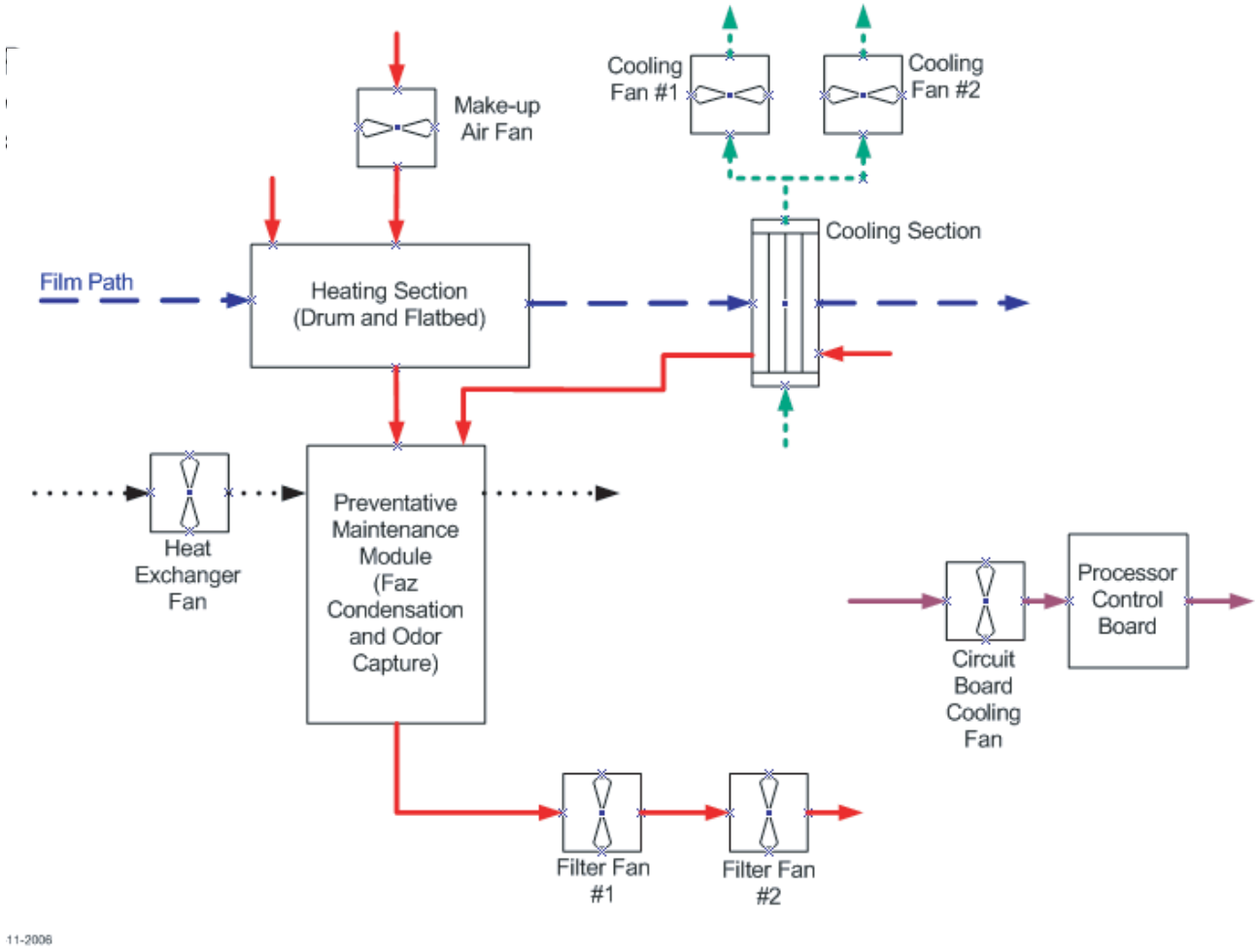
- To condense FAZ and other material.
- To increase the ability of the CHARCOAL in the PMM to “absorb” odors. The ability of CHARCOAL to “absorb” odors decreases at high temperatures.

The HEAT EXCHANGE FAN is OFF when the IMAGER is in “Standby” mode.

The 2 COOLING FANS pull air through the “hollow” ROLLERS in the COOLING SECTION. When the IMAGER is in “Full Run” mode, the PCB controls the speed of these FANS in response to the RTD in the COOLING SECTION. In “Idle-But-Ready” mode, these FANS run at low speed; in “Standby” mode the FANS are OFF.

The CIRCUIT BOARD FAN provides cooling for the PCB. It runs at full speed in all 3 of the IMAGER power modes. It receives 24 V DC power from the PCB but is not under software control.

Figure 26 **Air Flow and FANS**



APPLICATION SOFTWARE

The PROCESSOR application software executes in the 2 MICROPROCESSORS on the PCB. There are 2 separate applications. The primary application runs in the TEMPERATURE MICROPROCESSOR. The second application runs in the TRANSPORT MICROPROCESSOR. The software communicates with the MCS across the I2C network to control the HEATERS and MOTORS. It also reports measurements and status back to the

MCS. The 2 applications communicate with each other on the I2C network and through the shared NVRAM on the PCB.

"Initialization"

At system Power-up or when the MCS sends Reset signal, the application does 2 "initialization" tests:

- NVRAM test
- Checksum verification of the MICROPROCESSOR application code.

"Initialization" is completed within 30 seconds.

Operation

During normal operation the primary application reads RTDs, computes temperatures and switches 120 V AC HEATER power to the HEATERS when necessary to keep "setpoint" temperatures within 1/2° C. This application also controls film cooling. It reads the RTD in the COOLING SECTION and computes FAN speeds to keep the "setpoint" temperature for the COOLING SECTION.

The MOTOR control application drives the 2 STEPPER MOTORS to transport film through the PROCESSOR within 22.5 seconds.

Diagnostics

The application software checks for a number of "faults" within the PROCESSOR:

- Open RTD
- Short circuit in RTD
- Failed SOLID STATE RELAY
- Overheat condition

The application also starts diagnostic tests and a memory test when asked for from the MCS. Test results are returned to the MCS.

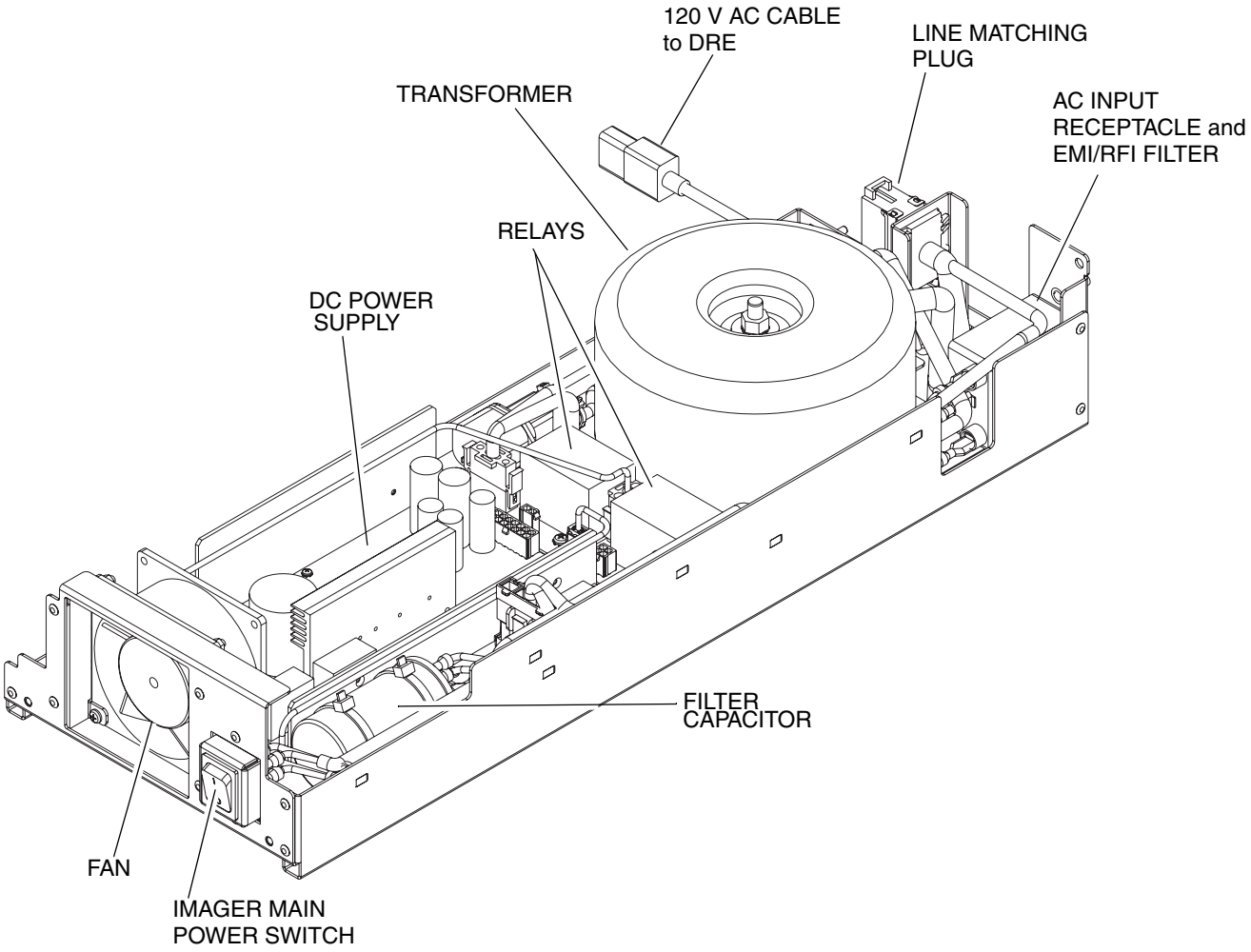
Temperature Offsets

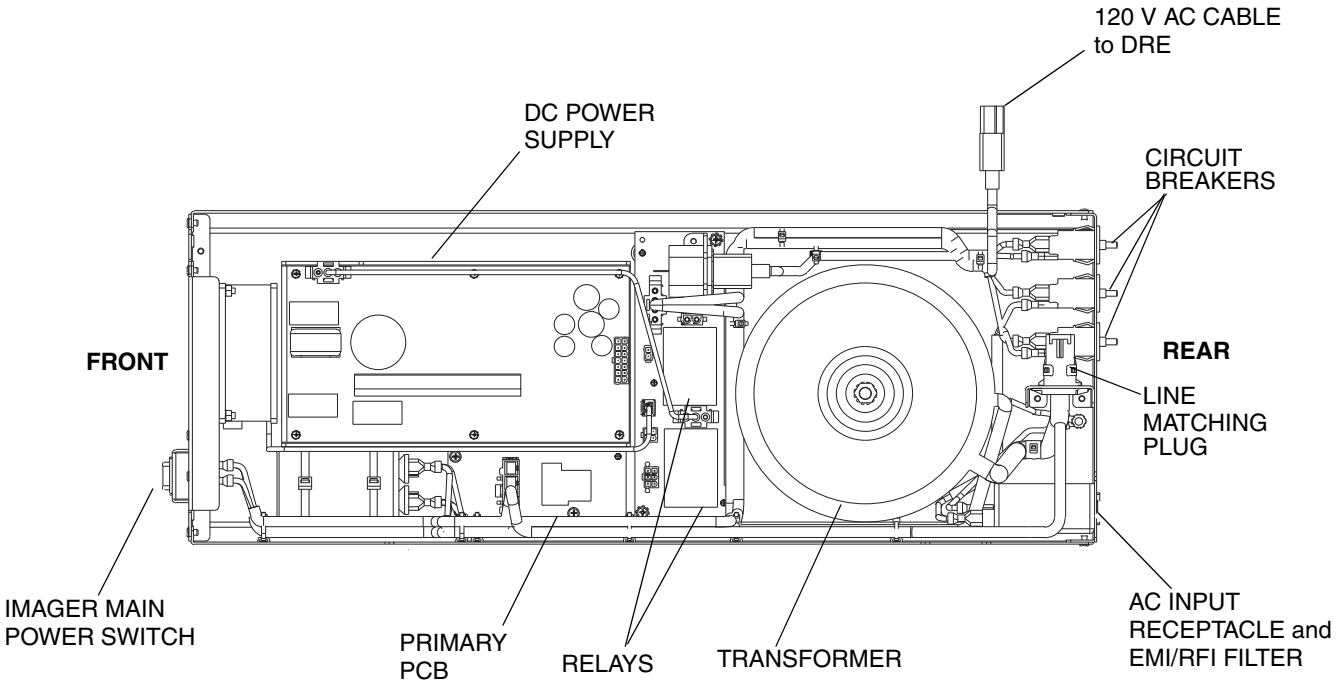
To be supplied

Section 13: POWER MODULE

The POWER MODULE supplies DC power to the CIRCUIT BOARDS in the MCS and 120-volt AC power to the HEATERS in the PROCESSOR DRUM and FLATBED. It also supplies 120-volt AC power to the DRE.

Physical Layout



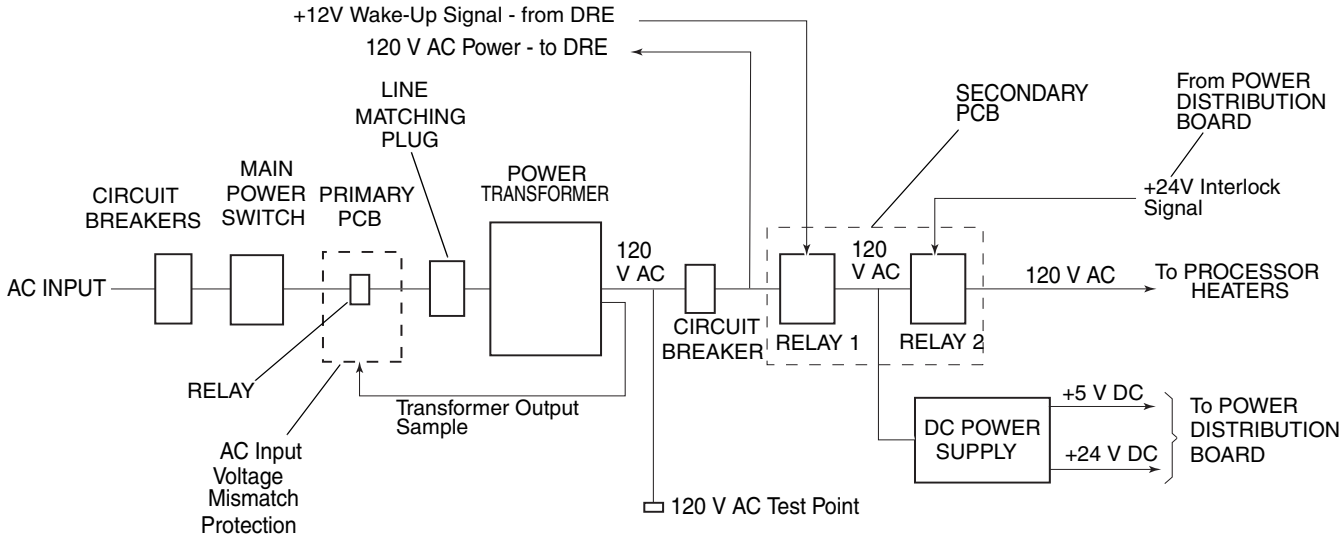


Functions

The POWER MODULE:

- Supplies 5V and 24V DC power to the CIRCUIT BOARDS, MOTORS and SENSORS
- Supplies 120 V AC power to the PROCESSOR HEATERS
- Supplies 120 V AC power to the DRE

The following block diagram shows the main components in the POWER MODULE. Refer to the 6800 FUNCTIONAL DIAGRAMS for a circuit diagram.



The POWER MODULE can be set up for any 1 of 5 input voltage ranges:

- 90 -105 V AC
- 106 - 130 V AC
- 180 - 210 V AC
- 211 - 230 V AC
- 231 - 250 V AC

A LINE MATCHING PLUG configures the primary windings of the transformer so that the secondary voltage is always approximately 120 V AC. Five LINE MATCHING plugs are supplied with the IMAGER, 1 for each of the possible input voltage ranges. The appropriate LINE MATCHING PLUG is inserted when the IMAGER is installed.

The TRANSFORMER supplies 120 V AC power to the DC POWER SUPPLY, the PROCESSOR HEATERS and the DRE. During normal operation, both RELAY 1 and RELAY 2 are energized to enable the 120 V AC outputs to the DC POWER SUPPLY and PROCESSOR HEATERS.

- A 12 V DC “Wake-up” signal from the DRE energizes RELAY 1 when the IMAGER is in the Ready state. If the IMAGER enters “sleep mode” or “Power Off” mode, the “Wake-up” signal goes low and RELAY 1 opens to interrupt 120 V AC power to the HEATERS and to the DC POWER SUPPLY.
- A 24 V DC interlock signal from the MCS electronics energizes RELAY 2 during normal operation. If an open door or other interlock condition causes the interlock signal to drop out, RELAY 2 is de-energized and interrupts 120 V AC power to the HEATERS. For a description of the interlock conditions, see **INTERLOCK SYSTEM**.

120 V AC power to the DRE is never interrupted unless the MAIN POWER SWITCH on the POWER MODULE is opened or a fault condition interrupts input power to the POWER MODULE.

Fault Protection in the POWER MODULE

The POWER MODULE contains two 15 amp circuit breakers at the AC input and one 15 amp circuit breaker at the 120 V AC output of the transformer. There are also 2 THERMAL SWITCHES in the transformer that open if the transformer overheats. The THERMAL SWITCHES reset automatically when the transformer cools.

The PRIMARY PCB protects against an incorrect LINE MATCHING PLUG. If the LINE MATCHING PLUG is not correct for the AC input voltage, the TRANSFORMER secondary voltage will not be correct (120 V AC). Circuitry on the PRIMARY PCB monitors a sampling winding on the secondary side of the transformer and energizes a RELAY on the PCB when the secondary voltage is correct. If the secondary voltage is not correct, the RELAY opens to interrupt the AC input path to the transformer.

The POWER MODULE also contains surge suppression circuitry.

Section 14: Publication History

Publication Date	Publication No.	ECO No.	Changed Pages	File Name	Notes
30JUL07	8F2924	CN0008638	--	8f2920.fm	• New Publication • Rev A

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